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City Hall, November 10, 1832.

At a meeting of the Joint Committees on Fire and Water, held in the room of the Board of Assistants, it was

Resolved, That Colonel De Witt Clinton be requested and authorised to proceed and examine the continuation of the route from Chatterton Hill, near White plains, to Croton River, or such other sources in that vicinity from which he may suppose that an inexhaustible supply of pure and wholesome water for the city of New-York may be obtained; also, his opinion of the best mode of conducting the same to the city, and the probable expense as well as the practicability of bringing the water across Harlem River, and the most suitable point where the same shall be, and the best mode of doing it, and that he be authorised to employ two assistants to aid him in the undertaking.

JAMES PALMER, *Chairman*,
CHARLES HENRY HALL,
WILLIAM MANDEVILLE,
GEORGE W. BRUEN,
PETER S. TITUS,
DENIS M'CARTHY.

At a meeting of the Committee on Fire and Water, Dec. 22, 1832, the following report was received from Colonel De Witt Clinton, and five hundred copies were directed to be printed.

TO ALDERMAN JAMES PALMER,

Chairman of the Committee on subjects relating to Fire and Water.

SIR,

I fully concur with your Committee on the practicability of obtaining for the city, a copious and inexhaustible supply of pure and wholesome water, at a reasonable expense, when compared with the utility and importance of the object. I therefore submit, in compliance with your wishes, the following report on that subject, embracing all matters connected either with its importance or feasibility.

2. I must however, remark, that in presenting the results of my labours and researches for the consideration of your committee, my opinions are formed under great perplexities and doubts, arising from the contradictory statements, and from the want of proper surveys, the intricacy of the investigations, and from the number of plans that have been in contemplation, and from a wide difference of opinion among our fellow-citizens, on the proper source to procure the water, and the manner and the route by which it ought to be conducted to the city. I should therefore, under all the circumstances, have declined the confidence of your Committee, if I had not been cheered by a faint hope that my investigations, in some small degree, might assist you in placing the question fully before your constituents, in order to secure their cordial co-operation in a work so essentially connected with their prosperity.

3. It is allowed by all, that the source from which the supply of water ought to be taken, should not only be equal to the present consumption of the city, but in sufficient quantities to provide for a dense and compact population over the whole island. Not that it is proposed at this day to construct works of sufficient capacity for

that purpose, but so to arrange the plan as to admit of its extension with the increase of population, revenue and demands of the city.

4. It is evident that if our prosperity, as a nation and a state, should continue uninterrupted, and our country augmenting in wealth, and in population, in the same ratio as during the last fifty years, sixty years will not elapse from this period, before this island will be inhabited by one million of souls. This remark will not appear exaggerated, when we reflect that in 1697, this city contained but four thousand three hundred and two persons; that Philadelphia, in 1800, exceeded it fifteen thousand; and at this time, its population is more than two hundred and twenty thousand. That the value of all kinds of property on the island, has increased within the last year, over twenty millions of dollars; and that it is now assessed at one hundred and forty-five millions of dollars; and that it is only since 1800, that New-York has been ranked the first commercial emporium of the country.

5. If this city has been so eminently prosperous in the last few years, what greater augmentation of her wealth and extent may not be reasonably anticipated, from the enterprize of her merchants, the skill of her mariners, the ingenuity of her manufacturers, the industry, patriotism and economy of her citizens; and also from the facilities, cheapness and despatch which the various avenues of inter-communication, natural and artificial, in the different states, have opened to her, and in the completion of new channels of communication; many of them in progress, and others in contemplation, tending to unite her more permanently, and more advantageously, with all parts of our improving and diversified country.

6. With such evidence of an augmenting and multiplying wealth and population in the increase of her ships, her manufactories, and the permanency and splendour of her public and private dwellings; and with the most conclusive evidence from her geographical position, and her proximity to the ocean, and the security of her harbour, that she must be to this country, what London is to England. It must not only be a matter of surprise and of profound regret, that she is destitute of a supply of good and wholesome water, and that there should exist any hesitation to grant her power to obtain an element so essentially connected with the prosperity, health and comfort of her citizens.

7. But why has this important measure been so long delayed by the city? Will it be found in the opposition of our fellow-citizens? It is believed not, as it is said a large majority of them are in favor of the introduction of water; but then, why has all former efforts of the city authorities been unsuccessful? It is not owing to causes over which they have no control; from an extraneous but powerful influence, which not only exerts itself in this wide community, but in our legislative halls; from the powers and immunities granted to the Manhattan Company; and from the diversity of opinion among the friends of the measure on the supply of water, the plan of the work, and the expense of the undertaking?

8. In 1799, a Company was incorporated, styled the New-York Manhattan Water Works, with a view to supply the City with pure and wholesome water. The Capital of the Company is over two millions of dollars; the Charter is perpetual, granting the Company the control over the Streams and Springs on the Island of New-York and the county of West Chester, for the above objects. It must, however, be recollected, that when the Charter was granted, that the population of the City was a little over sixty thousand persons; that the year previous, the Yellow Fever had visited the City with all its horrors and virulence, and the minds of all were filled under their calamities with great dread; that the Corporation evinced no disposition to embark in the work, and the character of the Well Water was generally good. It was also supposed, that good water could be procured from the Bronx, within a distance of twelve miles of the Old City Hall, for \$200,000, and the supposed consumption of the City was 300,000 gallons. We are now, however, informed by the Water Committee, in their Report of 1831, That the Manhattan Company, "have been more intent in making money by their banking operations, than accomplishing the avowed objects of their Charter, and have left the City totally unsupplied with Water, which can be called pure and wholesome, and over four-fifths of the paved parts of the City, without any supply whatsoever." With their Report, they give the following Analysis of the Manhattan Water, "By which it would appear, it is unfit for the use of Man."

9. One wine quart was slowly evaporated to dryness. The dryness weighed 31.45 grains, equal to 125.80 solid matter in the gallon, consisting

| | |
|---|--------|
| Of Muriate of Soda..... | 45 20 |
| “ Muriate of Magnesia..... | 40 00 |
| “ Sulphate of Magnesia..... | 6 00 |
| “ Carbonate of Lime, with a little Carbonate of Magnesia..... | 12 80 |
| “ Sulphate of Lime..... | 4 00 |
| “ Extractive matter combined with water..... | 17 80 |
| Mass in a gallon of water..... | 125 80 |

10. The works of the Manhattan Company consists of a Well in Cross-street, twenty-five feet in diameter, and two Steam Engines of eighteen horse power each; a Reservoir on Chambers-street, and one or two small wooden Reservoirs. In a Circular, signed by John Lozier, Esq., in 1823, he states, that the Steam Engines work sixteen hours in the day, and raise in twenty four hours, 691,200 gallons, which is more than one fifth greater than the capacity of the Reservoir; that twenty-five miles of pipes were then down, and the Company supplied two thousand houses, excluding manufactories, &c. He also remarks, “That the water was pumped very clear from the Well, and the Reservoirs so constructed with Strainers, that impurities of any kind, cannot pass into the pipe of Conduit.” That the Company had not expended less than \$400,000 in constructing the Works, and that the Well from which the water is obtained, was the Old Tea Water Pump, and was called *Tea Water*, and was considered the best on the Island.

11. The Manhattan Company since 1823, have employed Mr. Dinsbrow to construct a Well, near the corner of Bleecker-street and Broadway; its diameter is eight inches, and its depth is four hundred and forty-two feet.

12 The conclusions which we can draw from Mr. Lozier’s Circular in 1823, are these,—That the Manhattan Reservoir on Chambers-street, does not contain a quantity equal to the daily consumption, or it is five times filled and emptied in every twenty-four hours, and the water when distributed for use, is in the same state as the water in the pumps and well! That the Company have, on an average, laid one mile of pipe, mostly of wood, every year since its incorporation to 1823, and that the best pump water on the Island by having a dense population collected around its sources, has lost its goodness, and now contains foreign matter destructive to health.

13, The Manhattan Water Company have, however, the ability from their Charter, if not to defeat, at least to procrastinate the introduction of water by the City for many years. A contention with that Company, may, therefore, result in a vexatious suit, and defer the accomplishment of a measure so materially blended with the welfare of our fellow citizens for years, and be destructive to the prosperity of the City. But this subject is peculiarly the care of your Committee, and your views when once expressed, ought to guide the opinions of our joint City Council, and your determination in this matter ought to be well considered, and then followed up with energy, as it must rest with you to decide whether you will recommend coercive measures, or amicably adjust the difficulties, and cordially co-operate with that institution to secure the accomplishment of the subject of our investigations.

14. In 1823, the Legislature of New-York incorporated the Sharon Canal Company, with the power to make a Canal from the western boundary of the State of Connecticut to the City of New-York. The grant secures to the Canal Company all the water on its route for the use of its works, and to supply the City with pure and wholesome water.

15. The route of the Sharon Canal commenced in the State of Connecticut, at the junction of the Oblong River, with a small stream, which flows from the Mudge and other ponds. It followed the course of the Oblong River to the town of Dover, descending thirty-two feet below the starting point; it then entered the valley of Swamp River, and passed through the towns of Paulding, Patterson, and southeast to Crawford's Mill, on the east branch of the Croton River. The length of this part of the route is forty miles, and the fall from the dividing ridge, between the Croton and the Ten Mile River is fifty-six feet; making a total fall from the starting point of eighty-eight feet.

16. On the Sharon Canal Level, the greatest depth of cutting between the Ten Mile River and the Croton Valley, is fourteen feet, which extends for one hundred rods. The country is flat, and it would require a distance of one and a half mile before the level of the Canal would be entirely free of digging between the vallies. The level of the Canal, however, determines the fact, that the Oblong River may be turned into the valley of the Croton.

17. From Crawford's Mills the route followed the north bank of the Croton River, and within one hundred rods of Sodom Corners it crossed that river in an aqueduct to the south bank. From thence it continues in a southwesterly course on the level of the Aqueduct to North Salem on Titicus River; then to South Salem Academy, and to Cross River Village, and down the valley of Cross River to Governor Jay's, and then to, or near North Castle Corners; it then crossed over into Mill and Saw-Mill Rivers, and entered the valley of the Bronx, and passed by West Farms, and maintained an elevation of ninety-seven feet above tide, within one mile of Macomb's Dam.

18. Crawford's Mills, on the east branch of the Croton, is fifty-two miles from Macomb's Dam, and is four hundred and eight feet above it. The greatest obstructions appear to be on the part of the route between the head of the Saw Mill River and Crawford's Mills, and between that point and the Titicus River. On the route surveyed by Mr. Young, there are two Tunnels—the first is thirteen hundred and twenty yards in length, and the ridge is fifty-four feet above it; the second is seventeen hundred and sixty yards long, and the hill is eighty-four feet above its level. From Crawford's Mill the Canal is continued on a level for thirty miles, until it has passed into the valley of the Saw Mill River. Mr. Young estimated the expense of constructing the Canal between the Mills and the Harlem River, at \$365,862, or \$18,575 per mile. The dimensions of the work were twenty-eight feet bottom, water line forty feet, and the depth of water four feet. If this survey is to be considered accurate, it demonstrates the practicability of uniting the east branch of the Croton, the Titicus and Cross River, and Beaver Brook, and the upper branches of the Ciscoe Brook with the Saw Mill Valley, but at a great expense, and under great difficulty in execution. But this subject will be again examined, when I consider the supply of water.

19. In 1825, a new Company was incorporated, styled the New-York Water Works, with powers to supply the City of New-York with pure and wholesome water from the County of West Chester. In 1826, a report was made, and a plan submitted by Canvass White, Esq., Civil Engineer to the then Board of Directors; but owing to the difficulties in which the Company was placed by the

opposition of the Sharon Canal, and the Manhattan Company, nothing was done, and the Company voluntarily gave up their grant, which by its own duration would have expired this year.

20. In 1827, the Legislature incorporated a fourth Company, styled the New-York Well Company. The water was to be procured on the Island, by sinking wells on the most elevated grounds. The Company made several attempts to procure water, but being satisfied by their experiments of the impracticability of the undertaking, the concern fell through.

21. Having shown all the Companies that have been legally authorized by law, and the condition of the Manhattan Works, and their defects; I now turn with pleasure to the description of a work, that does the City and its projectors much and deserved credit; I allude to the CITY RESERVOIR in Thirteenth-street.

22. The diameter of the Well from which the water is procured is sixteen feet; its depth is one hundred and twelve feet—ninety-seven of which is excavated in solid rock; its bottom is sixty-two feet below common high tide. On the East side and within twelve feet of the bottom of the well, there is a horizontal passage which extends into the rock seventy-five feet, it is four feet wide and six feet high; on the west side there is a similar passage seventy five feet long, and with a branch twenty-five feet. They are both four by six feet. The object of these horizontal excavations was to increase the quantity of water, and to provide room to store it, in case of any sudden or unexpected demand being made on the yield of the well. The water rises in the well to within twelve feet of the surface of the ground, and it contains, with its horizontal passages, 175,150 gallons.

23. From the well the water is raised by a steam engine of twelve horse power, into an iron tank in a building of an octagonal form. The bottom of the tank is eighty three and a half feet above tide. It is forty-four feet in diameter, is twenty and a half feet high, and will contain 233,169 gallons. From the tank the water is conducted into the mains by curved pipes of twenty inches diameter.

24. The cost of these works appears to be, from a statement made to me by Mr. Wenman the late superintendant, as follows.

| | |
|---|-----------------|
| Cost of eleven lots of ground on which the works stand, | \$12,250 |
| Tank, \$4,200. Building for tank, \$5,041, | } 15,033 |
| Foundation of building and well, \$1,377, | |
| Foundation of tank including arching, \$4,415. | |
| Excavating well and passages | 9,000 |
| Steam engine and fixtures, \$5,250. Building over | } 5,950 |
| steam engine, \$700. | |
| Total cost of works, | <u>\$42,233</u> |

25. Since the purchase of the lots on which the buildings stand, real estate in that part of our City has very much increased in value. Mr. Wenman states, that the value of the eleven lots is now equal to \$20,000, which would make the present value of the works \$49,983.

26. The annual expense of keeping the above works in repair and in operation will be equal to the investment of a capital of \$63,000, drawing an interest of five per cent ; as will appear by the following calculation.

| | |
|---|----------------|
| The Salary of an Engineer and Firemen for 12 months.... | \$ 960 |
| Fuel of Engine, oiling, picking, and packing same | 1,368 |
| Averaged annual decay of boiler | 354 |
| Averaged annual decay of balance of machinery | 383 |
| Contingent expenses | 100 |
| Total annual expense, | <u>\$3,165</u> |

27. It therefore appears that the total averaged expense of building the reservoir, and maintaining the works and keeping them in repair, is equal to an actual expenditure of a capital of \$113,283.

28. From a statement now before me, it appears, that the City has laid the following extent of pipes.

Pipes twenty inch diameter, connecting bottom of tank with the mains in Thirteenth-street, 80 feet cost \$600.

Pipes twelve inches diameter, commencing in Thirteenth-street, to Third Avenue down to Bowery, Chatham and Pearl and William-street, and between William and Stone streets, 20,194 feet, cost \$46,546.

Pipes ten inches diameter, from Grand-street to Broadway and Bowery, from Bowery to Houston, to Bedford, through Bedford to Christopher; also from Chatham to East Broadway, and through East Broadway to Sheriff, making a length of 10,232 feet, the cost is \$18,746.

Pipes six inches diameter, from Bowery to Delancy and to Cannon, making 4,220 feet in length, the cost is \$4,960.

29. The aggregate lengths of the pipes is thirty-four thousand seven hundred and twenty-six feet, and the cost is seventy thousand nine hundred and fifty dollars, or two dollars, four and a half cents per foot as the mean cost of the whole.

30. It also appears that the following quantity has been ordered by the city, and delivered, but not laid, viz :—

For the Broadway line, Hudson and Chambers-street, twelve inch diameter, nine thousand four hundred and sixty-four feet cost eighteen thousand one hundred and seven dollars.

For Stanton-street, two thousand two hundred and one feet cost one thousand nine hundred and fifty-nine dollars, ten inches diameter.

For Sheriff-street, seven hundred and seventy-five feet cost six hundred and thirty-four dollars, six inches diameter.

31. The pipes which are laid in the city, are in pieces of nine feet length : the lap of the pipe is six inches, or when laid, one piece enters the other six inches, and makes each length of pipe, when laid, equal to eight and a half feet : the joints or laps are soldered with lead, &c., they are laid four feet deep in the ground.

32. The following table will show the expense of laying pipes of different dimensions—the quantity of lead used—the cost of ditching and covering—the expense of melting lead—and the cost per foot of pipes, as ascertained from Mr. Wenman, the late Superintendent ; when the pipes are curved, an additional allowance is made for casting them ; curved pipes are frequently necessary to avoid vaults, wells, drains, &c.

TABLE.

| Diameter of Pipes. | Cost of Pipe per foot. | Pounds of lead required for each joint. | Cost of Ditching, Unpaving and Repaving, &c., of streets, per foot. | Cost of Fuel for Lead, per Mile. | Cost of one mile of Pipe. |
|--------------------|------------------------|---|---|----------------------------------|---------------------------|
| 12 inches. | \$1 57 | 20 | 28 | 10 00 | \$11,345 67 |
| 10 do. | 1 38 to 1 50 | 16 | 23 | 9 50 | 8,997 29 |
| 6 do. | 0 80 | 10 | 14 | 6 00 | 5,253 76 |
| 4 do. | 0 50 | 7 1-2 | 13 | 5 00 | 3,759 15 |
| 20 do. | 4 08 | 79 | 56 | 43 50 | 27,295 65 |

33. Stop valves are necessary in case of any derangement of the pipes or leakage; there ought not to be less than five in the mile. Fire Plugs are also necessary, and also branch pipes from the mains, and on the cross-streets, will occasion an additional expense. In the table they are divided into double and single branches; there are also branches leading the water into the fire plugs, and bonnets at the ends of the pipes, to prevent the discharge of water. The following Table embraces all those items and their cost.

TABLE.

| Stop Valves. | | | Double Branch Pipes. | | | Single Branch Pipes. | | | Bonnets. | | | Branch leading into Fire Plugs. | | | Fire Plugs. | | |
|-------------------|---------------------|------------|-----------------------|----------------------------|------------|-----------------------|----------------------------|------------|-------------------|----------|------------|---------------------------------|----------------------------|------------|--|----------------------------|------------|
| Diameter of Pipe. | Cost of each Valve. | | Diameter of Branches. | Extra cost of each Branch. | | Diameter of Branches. | Extra cost of each Branch. | | Diameter of Pipe. | Cost of. | | Diameter of Pipe. | Extra cost of each Branch. | | Diameter of Pipe. | Extra cost of each Branch. | |
| | Inches. | Dols. Cts. | | Inches. | Dols. Cts. | | Inches. | Dols. Cts. | | Inches. | Dols. Cts. | | Inches. | Dols. Cts. | | Inches. | Dols. Cts. |
| 12 | 11 | 19 | 12 by 12 | 22 | 87 | 12 by 12 | 19 | 87 | 12 | 1 | 68 | 9 by 4 | 9 | 24 | The Plugs each \$28 50 Extra Pipe 11 48 Total Cost \$39 98 | | |
| 10 | 94 | 19 | 10 by 12 | 17 | 11 | 10 by 10 | 10 | 64 | 10 | 1 | 38 | 6 by 4 | 6 | 88 | | | |
| 6 | 61 | 19 | 6 by 12 | 15 | 79 | 10 by 10 | 6 | 71 | 6 | | 87 | | | | | | |
| | | | 10 by 10 | 14 | 76 | 18 by 3 | 6 | 56 | | | | | | | | | |
| | | | 10 by 6 | 11 | 84 | | | | | | | | | | | | |
| | | | 6 by 6 | 6 | 18 | | | | | | | | | | | | |

34. My object in thus presenting the expense of laying pipes is with a view to remove any doubts of the practical part of that operation, and to show that the expense is not so great as many persons suppose. It is also proper to observe, that by an experiment which has been made, that the water from the City Reservoir can be thrown from the fire plugs over the houses in any of the lower parts of the city, or south of the reservoir, or in its vicinity; and Mr. Wenman in a communication, says, "The effect and advantages of the City Reservoir, has already been seen and acknowledged by our citizens, in the stopping of fires, and the saving of property. I may venture to say, that the few pipes already down has been the means of saving more property than the whole amount of expenditures on the reservoir and the works attached thereto."

35. It is well known to all, that our city and county is situated on an Island surrounded by salt water. On the east it is bounded by the East River, and on the west by the Hudson. Those streams unite at its extreme southern point, the Battery. It is separated from West Chester by the Harlem River, through which the tides ebb and flow. The greatest length of the island, as measured on the plan of the city, from the Battery to Macomb's Mill at Kingsbridge, is 71,700 feet, or 13 miles 1,760 feet, and a mean of fourteen transversal measurements gives an average breadth of 8,500 feet, or 1 mile 3,220 feet. The greatest breadth is on the line of 88th-street, and is 12,200 feet, and the least is at 155th-street, and is 3,200 feet. The area of the island is about 14,000 acres.

36. The outline of the Island is not more irregular than its surface. The ground within two miles of Kingsbridge, at Fort Washington, and on the line of 183d-street is the most elevated. It is a source of much regret, that the elevations of that part of the Island have not been ascertained. From my own investigations, I am satisfied that the highest lands on the Island border on the Hudson, and are in the vicinity of the Tenth Avenue. The following Table contains the elevations of different parts of the City, and are taken from the maps in the Street Commissioner's office; they demonstrate the fact, that unless the works are taken to the Tenth Avenue, there will be in the upper parts of the City sec-

tions of it which will be deprived of all participation in the benefits which will arise from the introduction of water, unless it is elevated by machinery to those parts of the Island.

TABLE.

| Avenue No. 1. First Column shows the Street or Point at which the level is taken.— The 2d column the height above tide water. | | Avenue No. 3. First Column shows the Street or Point at which the level is taken.— The 2d Column, the height above tide water. | | Avenue No. 5. First Column shows the Street or Point at which the level was taken.— The 2d Column the height above tide water. | | Avenue No. 8. First Column shows the Street or Point at which the level was taken.— The 2d Column the height above tide water. | | Avenue No. 10. First Column shows the Street or Point at which the level was taken.— The 2d column the height above tide water. | |
|--|------------------|---|-------------------|---|------------------|---|-------------------|--|------------------|
| Street. | Feet. | Street. | Feet. | Street. | Feet. | Street. | Feet. | Street. | Feet. |
| 125 | 17 $\frac{3}{4}$ | 125 | 18 $\frac{3}{4}$ | 135 | 23 | 125 | 37 | 154 | 153 |
| 111 | 12 $\frac{3}{4}$ | 105 | 12 $\frac{1}{2}$ | 125 | 25 $\frac{1}{2}$ | 112 | 26 | 139 | 165 |
| 91 | 16 $\frac{3}{4}$ | 96 | 66 $\frac{1}{2}$ | 122 | 103 | 105 | 130 | 132 | 85 |
| 84 | 66 | 88 | 88 $\frac{1}{2}$ | 117 | 53 $\frac{1}{2}$ | 85 | 130 $\frac{3}{4}$ | 123 | 50 $\frac{1}{2}$ |
| 78 | 31 $\frac{3}{4}$ | 77 | 53 $\frac{1}{2}$ | 101 | 68 | 58 | 87 $\frac{3}{4}$ | 117 | 146 |
| 68 | 67 $\frac{1}{2}$ | 67 | 100 $\frac{1}{2}$ | 90 | 114 | 41 | 49 $\frac{1}{2}$ | 105 | 103 |
| 57 | 61 $\frac{3}{4}$ | 57 | 51 $\frac{3}{4}$ | 70 | 88 $\frac{1}{2}$ | 13 | 29 $\frac{3}{4}$ | 91 | 115 |
| 51 | 47 $\frac{3}{4}$ | 38 | 47 | 51 | 84 $\frac{1}{2}$ | | | 77 | 112 |
| 40 | 79 | 17 | 46 $\frac{1}{2}$ | 36 | 83 $\frac{1}{2}$ | | | 58 | 95 |
| 22 | 29 | 6 | 44 $\frac{1}{2}$ | 23 | 44 $\frac{3}{4}$ | | | 34 | 57 |
| North | 40 | | | 10 | 39 $\frac{1}{2}$ | | | 15 | 18 |

The greatest elevation of the Fourth Avenue is one hundred and seventeen feet above tide. At the intersection of 23d-street, it is fourteen and a half feet. The highest ground on the Sixth Avenue is one hundred and eleven and a half feet. The road at Manhattanville is twenty-six feet.

37. It is evident from the Table, the general slope of the Island is from the west to the east, and at points it is much broken by insulated and connected ridges and hills, and that there is an elevated range of high ground running from west to east, which slopes towards the northern and the southern parts of the Island. This fact is invaluable, as it will enable the Reservoirs to be so located, as to command at an elevated head, the whole City.

38. The general character of the soil of this Island is open, through which the rains that fall freely percolate. A small portion of its area consists of salt marsh and exposed rock. It is, however, commonly sand and gravel intermixed with pebbles and loose rock, resting on a stratified mass of gneiss, which exists at various

depths, and at places appears on the surface. The depth of soil has no regular uniformity, as ascertained by the boring of Mr. Dinsbrow's. At the Well on Thirteenth-street it is fifteen feet; at Bleecker-street it is forty-eight feet; at the Dry Dock it is one hundred feet; at Greenwich it is seventy feet; at Washington Market, and at Crane's Distillery it is seventy-two feet. We may, therefore, safely conclude, that in the lower Wards, the soil is the deepest on the rivers, and the rock rises with the slope of the Island on both sides, until it nearly approaches the surface of the ground in the lower wards.

39. It has been asserted by some, that the rock on which this Island rests is in uniform strata, dipping almost perpendicularly; and by others, that it dips in all cases towards the west, and becomes gradually less inclined, and assumes a horizontal position. Both of these theories, are in truth but the common deductions of speculative geology, and apply only to interior structure of our globe, when considered as a whole. They cannot, therefore, be properly applied to the internal arrangement of the rock on this Island, as it is evident from an examination that the rock on the surface has no uniformity in the angle of their dips, and in fact the strata preserve no harmony in their arrangement, as some are more inclined than others; and in different parts of the Island some incline to the south, and others to the west and the east. The rock does not also exist in strata of an uniform thickness. Take as an example, Mr. Dinsbrow's borings in Bleecker-street, the layers of rock are from nine to sixteen feet in thickness.

40. Among the different plans proposed to supply the city with water, is the one contemplated by Levi Dinsbrow. His scheme is to perforate the rock by boring until good water is obtained, and to exclude the bad by tubing. The water from the well to be raised for distribution by steam engines, and also reserved for use in a suitable reservoir. He, as I have before stated, has made several perforations on the Island. The most important is the one of the Manhattan Company on Bleecker-street. He has also made several others varying from 250 to 72 feet in depth.

41. That such perforations, as contemplated by Mr. Dinsbrow, will intersect veins and springs of water, which have their origin on higher land, is no novelty. It is true, that this fact was acciden-

tally discovered by a common drainer in England many years ago, who applied it to the drainage of lands. By this discovery he realized a splendid fortune, and obtained great fame. His whole theory consisted in the position and densities of the strata. That the water in a porous stratum, being confined by denser ones, and by penetrating through the compact layer would be released and come up to the surface in the form of a spring or jet.

42. That the plan of obtaining water in the above manner may succeed on a small scale, and for the supply of families, and manufacturing, in which the quantity consumed is inconsiderable, is not problematical. But when you extend the system, so as to embrace a whole community, it presents a different aspect, and becomes by the extent of the proposition, in the broad sense of the word, an experiment of very doubtful character, and as such I propose to investigate it.

43. It is a fact that a perforation, if sufficiently deep, will produce water, and by tubing out the bad springs and veins, it may be of excellent quality, soft, cool, and palatable. But it does not follow as a necessary consequence, that the rush of water into the well will be equal to the depth, as the water may be all bad, and excluded, except one vein, or it may be the whole quantity entering may be good and fit for use. The diameter of the well in Bleeker-street is 8 inches. The City reservoir well is 16 feet. The first is 442 feet deep, and the latter 112 feet.

The well in Bleeker-street contains1,154 gallons.

“ City Reservoir Well.....175,150 “

Difference in capacity.....173,996

It must be evident to all that the chances of meeting with water, and augmenting its quantity, is increased by the extent of the excavations, and if we compare the circumferences of the wells together, we will find that the perimeter of the city well is twenty-four times greater than the other. That the area of the circle in the first case, is five hundred and seventy-eight more than the other, and that the united area of the sides of the horizontal passages have sixty-two and a half chances of intersecting water, over any difference in depths of the well. It is also generally asserted as a fact, that there are veins of water between each stratum of

rock. If this is so, it does not alter our position ; as there would still remain all the chances of the greater excavation encountering water, over the smaller one.

44. The Water Committee, in their report in 1831, state that it would require two hundred similar perforations with the city well, to supply four millions of gallons. It would therefore require, when this Island is densely inhabited, over one thousand wells to supply one million of people. Those excavations would also penetrate through the same rocky strata, and the water would be drawn from the same sources. In such a number of deep wells, supplied from the same interior fountains, have we any evidence that their supply would be equal to the demand ; or, from the inclination of the rock, that the lower wells would not drain the more elevated ones, or cut off their supply. This powerful and subtile agent, originating in greater distance and on more elevated lands than on this Island, may by some submarine convulsions of nature, or by causes produced by its own power in its subterraneous routes, be diverted from its present courses, and its virtues lost. Also the numerous perforations, the constant suction of the pumps, and the accumulation of inhabitants in the vicinity of the wells, may completely change the character of the water, and what is now good may become very bad.

45. There is one striking advantage in the city well over the perforations proposed by Mr. Dinsbrow. That work is in fact a reservoir in itself, and in which the water is storing while the machinery is at rest, while in the plan of the latter, it is necessary that there should be a quantity of water entering, equal to the daily consumption of the part of the city in which it was situated, and would render it necessary that the engine should be in constant operation during the twenty-four hours ; and as the principal consumption would be during the day, it is therefore evident, that the capacity of his tanks would have to be greater by 163,096 gallons than the city well, if the perforation supplied a quantity equal to that work.

46. I have no experiments of my own to show the quantity of water a well or bore is capable of supplying in twenty-four hours

on this island. It is, however, certain that the quantity may vary from local causes. The well on Thirteenth-street supplies 20,000 gallons. The one on Bleecker-street, Mr. Sullivan states, yields 44,000 gallons in twenty-four hours, "but it could be made to supply 120,000 gallons, which would be equal to the necessary supply for a ward."

47. It will be recollected that Mr. Dinsbrow's plan was to supply the city by a well and reservoir in each ward. It therefore appears, that if each ward required 120,000 gallons, it would render it necessary, from the actual experiment made at the Bleecker-street well, to have three wells of equal depth and yield, to supply each ward; and if we take the result of the city well, it would require six of equal capacity to supply the demand. But the question would naturally be asked, which of these experiments are to be relied on. To solve it we must recollect, that the experiment made on the city well, was by a steam engine of twelve horse power; and the water was not only raised from the well, but deposited into the iron tank for distribution; while in the latter experiment, the water was pumped from the perforation by a six horse power engine, but not elevated, and for no considerable space of time.

48. The city at this time, contains fifteen important wards, and when this island is covered with houses, it will contain forty-eight or forty-nine wards. The following calculation will show the expense that the city would be put to by adopting Mr. Dinsbrow's plan, and providing the works should be as equally expensive as the City Water Works.—1st. On the supposition that one well would be sufficient for each ward:

| | |
|---|-------------|
| Fifteen Wells, Steam Engines, Pumps, Reservoirs, and houses at \$49,983 each | } \$719,745 |
| Maintaining fifteen Wells and Machinery, equal to an investment of a capital of \$63,300 for each, at 5 percent. | } 949,500 |

\$1,769,245

On the second supposition that three wells will be necessary to supply each ward.

| | |
|--|---------------|
| Forty-five Wells, &c., at \$113,283. (Cost of Wells and investment of capital for each work) | } \$5,097,735 |
| | |

On the third supposition that six works would be required by each ward.

Ninety Wells, &c., at \$113,283 each.....\$10,195,470

Now if we extend this calculation to the whole Island it would stand :

On the first supposition—Forty-nine wards—Cost of supplying same.....\$5,437,584

On the second supposition—Forty-nine wards16,652,701

On the third supposition—Forty-nine wards.....33,305,402

It is true, that by having the reservoirs so conveniently located that something would be saved on the pipes and the mains. There might also be something saved on the iron tanks and buildings. The steam engines would be a constant source of annoyance to the neighbourhood in which they were located. And it must also be evident, that if the island consumed, for all its uses, with one million of inhabitants, 20,000,000 gallons of water, it would require on the first supposition (well to yield 120,000 gallons each) 167 Wells, which would cost\$18,918,261

On the second supposition (44,000 gallons each well, 456 Wells, which would cost.....\$50,527,048

On the third supposition (well to yield 20,000 gallons each) 1,000 Wells, which would cost.....\$113,283,000

49. From the above remarks and calculations, it appears that the result of the experiment is so doubtful, its expenses so great, and the inconveniences which would result from it so many, that it would be unwise for the city to embark in the project.

50. At an early period in the history of the City, it was found that the well water was deteriorating in goodness. Mr. Weston in an able report in 1799, notices this important fact, and at this day it is too evident to be denied. I cannot, therefore, place this subject in a stronger light than to quote the words of a report made to

the Lyceum of Natural History in 1831, by several highly literary and scientific gentlemen.

51. "The sand bed of this Island may be regarded as a filter, or sponge which under ordinary circumstances, is filled with fresh water from the atmosphere. If this spongy mass was itself originally free from any mineral impregnations, and its surface always open, the water would of course remain pure for any definite period, when this filter itself contains any foreign ingredients, and the free transmission of pure water is prevented, its quality must be impaired; from actual data, the obstacles to the transmission of water from the surface of dwellings and pavements, are estimated to carry off to the river, nearly one half of the water from the atmosphere. In the neighbourhood of large open squares, it is constantly observed that the wells are more pure, but they must sooner or later partake of the same deterioration. The water in the immediate vicinity of the Park, although very *impure*, is nevertheless of a better kind than that of more distant wells, and we have been informed that the well of the Manhattan Company is mostly supplied from that quarter. It has also been observed, that wells in the vicinity of *grave yards*, communicate a ropy appearance, and the water of such wells, become in very warm weather very offensive in the course of a few hours. If the above facts be well founded, we must naturally anticipate a deterioration of our waters *pari passu* with the increase of our City; and we accordingly find this to be the case. Until the last few years, the water on the most elevated ground in Broadway, which are now supplied through the year with water carts from the country, and in the direction of Laurens-street, we have been informed that this foreign supply is required still further north of Broome-street. But we are now to allude to another cause, which must greatly impair the purity of our waters, into the sand banks underlaying our City, are daily deposited quantities of excrementitious matter, which were it not susceptible of demonstration, would appear almost incredible; with our present population, there is put into the sand, about one hundred tons of excrement in twenty-four hours. In these deposits, we may find all the ingredients detected by analysis, and which destroy the purity of our waters.

“The coldness of our pump water conceals the impurities when swallowed ; this may be tested by allowing it to stand until it acquires the ordinary summer temperature. Its various ingredients then become manifestly palpable. These impurities are not caused by the additional heat, they exist at all times in the water, their presence is only disguised for the moment by its coldness, and its injurious properties are in no wise diminished.

“From whatever quarter the supply is obtained, it must be from places beyond all possibility of ever being surrounded by a dense population. It must also be secured in sufficient abundance to provide for the wants, not only of the present, but future generations.”

52. I have been informed that the pump water is generally very bad and deleterious in character, in a line from the Hudson River to Spring-street, and from thence to the Bowery, to the Third Avenue, and thence to Thirteenth-street and the East River. In the remaining parts of the city, it is generally indifferently good, but it is also annually losing its purity.

53. Many parts of the City are now supplied with water, brought from the upper wards. On the East and the North River, in some instances, it is pure, and in others its goodness is but little better than the present well water. The tables of the wealthy are supplied from this source, while our poorer classes have to resort to such wells or pumps as are in their neighbourhood. I therefore considered it important to ascertain what the present supply is ; careful and minute inquiries were made, and the result was, that there is now daily brought to the City by drays or water carts, six hundred hogsheads, for which there is paid one dollar and twenty-five cents, (or about two cents per gallon) for each hogshead, or \$750 per day, or \$273,750 per annum, for water from that source. There is also much inconvenience in obtaining the above supply, which frequently leads to an increased expense, and difficulties in procuring it. The sum paid for water, is also annually increasing, owing to Wells and Springs, which are now pure, losing their goodness. It is also proper to remark, that our City as it augments in population, the sources from which it is now supplied, will also be-

come impregnated with foreign matter, which will render it necessary to resort to more distant Springs, which must very much increase the expense of providing water.

54. Many of our large hotels at this time, pay from \$200 to \$450 annually, for water ; and our smaller classes of boarding and private houses, pay from fifteen to fifty dollars for the same.

55. I am informed that our shipping are now principally supplied with water, procured on Long-Island at Brooklyn, and a small quantity from the Jersey shore and from Staten-Island, and some of the steam-boats and small coasting vessels, from the Manhattan Works and the Pumps and Springs on the Island. Other coasting vessels and foreign packets and ships, provide themselves with a sufficient quantity abroad, to serve them for the trip, and to avoid the expense and detention of obtaining it in our harbour. The daily averaged supply as ascertained from careful inquiries from Brooklyn, for three hundred and thirteen days, (no water is delivered on Sunday,) is equal to three hundred and seventy-five hogsheads, (or 23,625 gallons.) On this there are two prices. The first is thirty-one cents per hogshead, when the water is delivered opposite to the City. The second is fifty cents, when it is carried to vessels laying at the Quarantine. It is stated that two-thirds of the quantity is delivered opposite to the harbour, and the balance, one-third, is taken to the Quarantine. To the above quantity is to be added the supplies delivered at our piers and wharves. This is supposed to be, from the best information I can obtain, equal to forty hogsheads per day, and is probably below the true amount. The following table will show the actual quantity and cost of the same for a year.

TABLE.

| Hogs- heads de- livered per day. | Gallons per day. | Hogsheads delivered per year. | Gallons per year. | Cost of hogs- heads. Cents. | Amount paid per day. Dollars. | Amount paid per year. Dollars. |
|---|---------------------|-------------------------------------|----------------------|---------------------------------------|---|--|
| 250 | 15,750 | 78,250 | 4,929,750 | 31 | 77 50 | 24,257 50 |
| 125 | 7,749 | 39,125 | 2,464,875 | 50 | 62 50 | 19,562 50 |
| 40 | 2,520 | 12,520 | 788,760 | 50 | 20 00 | 6,260 00 |
| 415 | 26,019 | 129,895 | 8,183,395 | | 160 00 | 50,080 00 |

56. Among the plans which have been urged on the City to obtain a supply of water, is one from the Passaic River at Patterson, either above or below the falls. There is in possession of your Committee, two memoirs on that subject, by John L. Sullivan, Esq., Civil Engineer; also, an overture from Rosewell Colt, Esq., the governor of the Manufacturing Company, stating the conditions and the price at which he was willing the city should have the water, and a proposal from Francis E. Phelps, Esq., for the construction of the works; the water to be delivered through twenty eight inch iron pipes for \$1,932,263. The water, in his proposals, was to be taken above the falls, and passed under the Hudson River by pipes laid on its bed. But if we admit the practicability of such an undertaking, the time which would be necessary to construct the work, and the great expense which would attend it, (as the proposal of Mr. Phelps is only for two millions of gallons, and the City now requires five millions,) and with the objections stated by that gentleman, such as the source of supply being within another State, the danger of the pipes being ruptured from drawing anchors, and the *impurity* of the water of the Passaic, condemns the whole scheme.

57. A plan similar in every other respect with the Passaic project, except the supplying point, and equally objectionable, has been proposed. It is to take the water from the Morris Canal, in the vicinity of the inclined plane near Newark.

58. It has been strangely asserted, by a few otherwise intelligent and scientific men, that it was practicable to introduce into the city the water of the Hudson river, at some point above Poughkeepsie, by laying a train of mains on the margin of the Hudson river. In this case there is not over a few feet fall in the whole distance, and not sufficient to overcome the friction in the pipes for one mile. The pipes would also have to be laid on the beds of many streams near their mouths, and passing by rivulets and streams of water of great purity. The ice of the Hudson river would also sweep away or injure the works in the spring. I think we may therefore pronounce the whole plan to be very visionary.

59. The investigation of such plans may be interesting to scientific and enquiring minds, but must result in a complete demonstration of their impracticability. I now, therefore, turn to an examination of the true sources from which this city must be supplied with water, if the plan is intended to meet the expectations of the public and the consumption of the city.

60. It is in the county of West-Chester; and from its streams, its lakes, and its springs, that the supply must be procured. The water in that county is generally soft, and of chrystaline purity, and great coldness. It is on those sources we must rely, as the water obtained must possess great salubrity in its character to ensure its use for all the purposes of the city.

61. The Byram, the Bronx, the Saw-mill, and the Croton rivers, with their numerous tributaries and lakes, are the sources from which it has been proposed, at different periods, to supply the city with water; and as there exists much diversity of opinion among our fellow-citizens respecting those streams, I shall endeavour to place this subject correctly before you. I only regret that the limited facts in my hands, will prevent me from placing it as distinctly before you as I could have wished.

62. Byram and Wampus ponds are the head of the Byram river. The outlets of those ponds unite within three miles of their origin. The stream then flows in a south-westerly direction: it then changes its course and enters the state of Connecticut, and before it passes into the Sound, forms a part of the boundaries between that state and New-York. It discharges into the Sound within a distance of twenty-three miles of Little Barn Island, situated near the mouth of the Harlem river. On this stream there is much valuable hydraulic machinery. The outlet of the Byram pond, I have been told, is, in some seasons, almost dry, and, in others, entirely so. This is not, however, often the case. The lands around the pond are generally elevated, except at the outlet: at this point the valley is low, swampy and wide. It is singular that the water in the northern parts of the pond is clear, and at the outlet, it is thick and muddy. The Wampus pond is also surrounded by high grounds, except at its outlet; and the discharge from the pond is

much more permanent and equal than the other. The water at the upper or northern end is thick and muddy ; at the outlet it is clear and pure. The first pond contains an area of one hundred and twenty acres ; the second, fifty-five acres.

63. The valleys of the Byram and the Bronx are separated from each other by a ridge of high ground, varying considerably in its relative elevation. An opinion of the proximity of those streams may be better formed, when I mention the fact, that the Wampus pond, which lies the most westerly of the Byram waters, is within a distance of one and a quarter miles of the source of the main branch of the Bronx. They, however, keep diverting or lengthening the distance between each other, until they discharge into Long-Island Sound ; at which point they are eleven miles apart. Between their mouths, on the line of the Sound, there are several streams, such as the Hutchinson river, which rises from a pond in the vicinity of White Plains, and enters the Sound between East Chester and Pelham. Those streams, with their branches, make the country more or less broken, between the principal vallies I have before mentioned.

64. The Bronx river is formed from three principal branches. The most southerly is the Sprain, or Valentine's Brook ; and the main stream, (which rises in a swamp situated on the high-lands, which separate the waters flowing into Long-Island Sound and the valley of the Croton) and the branch which flows from the Rye ponds. There are also numerous other rivulets and springs flowing into the Bronx, which, although discharging within themselves but small quantities, augment considerably its waters. It is proper here to mention, that owing to a depression in the ridges, it is practicable to introduce the waters of the Byram river into the Rye ponds. The Bronx, after passing through a rich agricultural and improving country, the surface of which presents to the eye an alternate succession of low valleys, and elevations, and level lands, flanked by ranges of higher grounds on the east and the west : it discharges into Long-Island Sound, nearly opposite to Flushing bay, and distant about four miles from Little Barn Island. The Rye ponds united contain about two hundred and forty-five acres :

they are distant about thirty-four and a half miles from the City-Hall. These ponds present two handsome sheets of water, surrounded by moderately elevated lands, and with principally rocky shores, except at their upper ends, where there are a few acres of low ground, which would be liable to be overflowed by the water. There are also indications that the ponds have once been many feet higher than they are now. The water flowing in the outlet is clear, pure and soft, and is principally supplied by submarine springs.

65. The face of the country which lies between the Bronx and the Hudson river, is very much broken by the valleys of different streams. The southern slope of the ridge on the Harlem river is indented by the Morrissenca and Mill creeks; and the continuation of the ridge westerly is again separated by a creek, which lies nearly in a parallel line with the course of the Bronx, and enters the Harlem river a short distance west of Macomb's mills. It rises on a low piece of ground, within seven hundred and fifty yards of the Saw-mill river, and in fact separates those streams. On the east side of the first stream are the high grounds which border on the Bronx; and on the west, the more elevated lands which lie on the Hudson river. The small creek therefore destroys the connection of the ridge between the Bronx and the Hudson as far as the Saw-mill valley. If we trace the high ground which lies on the west side of the Bronx, from that point we will find the first break in it near the Unionville church, through which it is proposed to turn that stream into its valley; from this point the ridge becomes less elevated, and is at last lost among the high grounds which are on the south bank of the Croton river.

66. The first considerable stream we meet, in ascending the east bank of the Hudson river, is the Saw-mill: that stream discharges within four miles of King's bridge: its valley lays for a considerable length of its course nearly parallel with the Hudson: it then turns abruptly to the west, and flows into the Hudson river. The sources of the Saw-mill originate on the high grounds on which the Ciscoe, a branch of the Croton, likewise rises. On the west and north-west side of the Saw-mill, extends a range of elevated and broken lands, in which originate many small streams, which run in a west-

erly course : the largest is the creek that enters the Hudson in the vicinity of Sleepy-hollow. On the Saw-mill river, there is much valuable hydraulic machinery ; and I am informed, that in dry times, they have not more than enough water for the present use, and that the volume of the stream has very much decreased within the last twenty years.

67. The Croton river is one of the largest and most durable streams in Westchester county : its waters are uncommonly pure, as they are principally formed from springs and from lakes ; and its branches and the main stream flows over gravel and sand beds, or over broken masses of rock and compact sand stone. The banks of the stream are also generally high and elevated, and unforbidding in character to the settlement of a dense population on its borders. The Croton river enters the Hudson near Teller's point : the principal branches are the Muscoot, which rises in the Mahapook pond, seven miles in circumference, the Ciscoe river, the Cross river, the West Branch, with its numerous tributaries, the Titicus, and the East Branch, which rises in very low grounds in the town of Patterson. There are also numerous lakes and ponds which lie at the head of most of the streams, and many spring branches of very pure and chrystal waters.

68. The streams which fall into the Croton on the southern bank, generally head opposite to branches of the Saw-mill, the Bronx, and the Byram rivers, and opposite to the sources of several other streams which rise in Westchester county, and flow through the state of Connecticut into Long-Island Sound.

69. In the above description having given a full account of the streams from which water must be obtained, I shall now turn to the various plans which have been at different times recommended or suggested, to obtain water from them to supply the city.

70. In 1795, Doctor Joseph Brown submitted to the Common Council a plan for supplying the city with pure and wholesome water. This report is accompanied with many profound remarks, exhibiting his varied talents as a mathematician, a mechanic, and careful observer of the hydraulic works then existing in Europe. But in the practical demonstration of his plan, he was far from being successful, and his opinions on the expense of the under-

taking, and the quantity of water then required by the city, are very erroneous, as will appear. He says in his report, "about half a mile below Williams' Bridge is a piece of low meadow ground, in which rises two springs, one of which runs easterly and empties itself into the Bronx, and not more than four hundred yards from its origin. The other spring empties itself into the Harlem river traversing a distance of about six miles. The place on which those springs originate, are not more than five feet above the level of the Bronx; and sometimes part of the river, when raised by a considerable freshet, has run over part of this meadow and emptied itself into the Harlem river. From these reasons then it is obvious, that by building a dam five feet high across the Bronx, and below where the first mentioned spring empties itself into, and by digging a canal four hundred yards in length through the meadow, the whole of the Bronx might be if necessary diverted from its old route and thrown into Harlem river, and about eight miles distant from the City-Hall." The spring to which he alludes, is the Morrissene creek. The point at which the work was to commence is fifty feet above tide, and the City-Hall was the old building in Wall-street. He also says, "when I first interested myself on this subject, I was in hopes a place sufficiently high might have been found, from whence the waters of the Bronx could have been conducted to New-York, in pipes of conduit, without any previous machinery; but I am now satisfied no such place exists, for although water in an open aqueduct will run with tolerable fluency, having only six inches fall in the mile, yet in a pipe, or conduit, it requires five feet fall to produce the same effect; and even this fall is insufficient where the pipe of conduit are of considerable length, and of small diameter, for the friction that is occasioned by the sides of the pipe of conduit, is in a quadruple ratio with its length. Now as the ground in the city of New-York, to which water ought to be conveyed to a principal reservoir, is about forty feet above high tide, which is ten feet only below the level of the river Bronx, where it may be diverted, I consider it a fall perfectly inadequate to any design of conveying the water in a line of pipes: it then becomes necessary, that the water of the Bronx should be elevated by the means of some machinery."

71. By this plan, the water was to be elevated eighty feet above the level of the Harlem river. The machinery was to be propelled by the surplus water from the Bronx, which discharged twelve hundred cubic feet in a minute. He was to have one water wheel and four pumps of six inches bore, which was to supply 362,880 gallons of water in a day, a quantity which he supposed was amply sufficient for the city. His reservoir was to be at a place called the Dove, which then was five miles from the city. He estimated the expense of all the works at \$201,000.

72. I have now to call your attention to a report made in 1799, by William Weston, a civil engineer of great reputation, to the Honorable Richard Varick, then Mayor of our city.

73. His plan was to take the water of the Bronx river at Lorillard's snuff factory; to raise a dam six feet high which would turn the water through a low swamp into Mill brook; to follow the north bank for three miles, and then to cross in an aqueduct to its opposite side, and continue that level to the Harlem river. He states the distance to be from the Bronx to the Park, 14 miles and 7 furlongs, and the descent at twenty-three feet. He says, "It appears from examinations that have been recently made, that the Bronx is sufficiently elevated above the highest parts of the city to introduce its waters therein without the use of machinery, and the intermediate ground, though very irregular, presents no obstacles which art and industry may not surmount." He also says, "An absolute necessity to preserve a regular and uniform descent, leaves us little room in the choice of our route which will be chiefly along the shore of the North river."

74. Mr. Weston estimated that the city would require 3,000,000 of gallons of water a day. He states that the Little Rye pond contained fifty acres, and the Big Rye pond, five hundred acres; those ponds he proposed to convert into reservoirs, by building a dam six feet high, which would make more than six hundred acres, and would contain 959,713,920 gallons, and would afford an annual supply of 8,000,000 of gallons for one hundred and twenty days, and leave a surplus of 5,000,000 of gallons for the mills. It will however be remarked, that he estimated the area of the

ponds double what they actually are. His water was to be brought into an open canal to the Harlem River: that stream was to be crossed by a cast Iron cylinder of two feet diameter, with a descent of eight feet. His reservoirs were to be divided into three parts, and two again of them subdivided. The first two divisions he called the reception apartments, which were to be filled with the water from the cylinders; while one was filling, the other would deposit the impure particles contained in the water. In every twenty-four hours, one of these chambers was to be drawn off in one of the subdivisions, which he called the reservoir of filtration, and from thence into the division of distribution, after percolating through a bank of gravel and loose sand: this last division of the reservoir was to be arched over.

75. There was also another plan considered by Mr. Weston. I allude to procuring a supply of water for the city from the Collect pond. That measure he condemned, and as that part of the island is now covered over with a compact population, it must be unnecessary to mention his opinions or calculations on the subject.

76. The late Robert Macomb, in 1819, proposed to procure a supply of water for the city, by using the Bronx river at Williams' bridge. The distance, as stated on his map, is four miles. The elevation of the Bronx is fifty-five feet. The rout followed the Morrissenea and Mill creek to the Harlem river. The ridge between those creeks was to be tunneled, its length was five hundred and twenty yards, and the ground was fifty-two feet above the bottom of that work. His plan is in the office of the Street Commissioner.

77. Since 1819, surveys have been made by the authority of the City, and by the New-York Water Company, and as many plans were presented, I consider it my duty to place them all before you, as I am anxious that they should all come under the consideration of your Committee, to secure the City from undertaking works which must eventually lead to disappointment, and to unnecessary expense in their execution.

78. If we commence at the Manhattan Reservoir, and follow the line of mains proposed by Mr. White to a reservoir marked number four on his map, and located between the Fifth and Sixth

Avenues and 42d and 39th-streets. The distance is three and a half miles, from that point to reservoir number one, at Devoe's Point in West Chester County, the distance is five and three quarter miles, or nine and a quarter miles from the point of commencement. The distance from reservoir number one to the cotton factory, on the Bronx river is twelve miles, and the elevation of that place above tide, according to a late survey made by Mr. Dewey, is one hundred and one and three quarter feet, and according to Mr. White, at Underhill's mill, is one hundred and thirty-two and a half feet; at Davis' bridge, one hundred and ninety-eight feet; at the junction of the Bronx with the branch from Rye Ponds, two hundred and twenty-four feet; at the Little Rye Pond, two hundred and eighty-eight feet; and at Big Rye Pond, two hundred and ninety and a half feet above tide. You will understand that the above elevations are taken from a plan made by Mr. White in the Street Commissioner's office, and I suppose are accurate.

79. The survey was extended from Rye Pond to the Byram Pond, in Connecticut. Mr. White says, alluding to the Byram River, "This river can be easily turned into Rye Pond with little expense, being separated by a swamp, and a ridge of gravelly soil, through which a tunnel has been constructed for the purpose of draining a swamp, and by this means the water is conveyed into Rye Pond, and in high floods, some of the waters of Byram River passes through this artificial outlet." In his report, in 1826, he says, "Byram Pond is the head of Byram River, although Wampus Pond, is the principal source. Byram Pond lies much higher than Rye Pond, and a communication can easily be made between them; the distance is about six miles, principally over bottom lands." He also says, "The country has been examined, with a view to connect Cross River with the Bronx, and also to connect the main Croton with the Bronx; but the intervening ground has been found too high and rocky to accomplish this object." The examinations, therefore, as far as they go, settles the question of the practicability of uniting directly the main branch of the Bronx or the Byram, or the Wampus Ponds with the Croton River.

80. In the report of Mr. White in 1824, he remarks, "A route has been surveyed from the Bronx River to the Saw Mill River, near Unionville church, and found practicable to turn the waters of that river into the Bronx, at a moderate expense; the deepest excavation necessary between the two streams will be about eight feet; the route passes through a swamp, and is designated on the map by a red line."

81. The distance from the Chambers street reservoir, on Mr. White's map to the point where he was to take the waters of the Saw Mill River, is thirty-four and a quarter miles. He also remarks, "that considerable time has been expended in examining the country for the purpose of connecting the Croton with the Saw Mill River; but no route has yet been found to accomplish this at any reasonable expense. The examination has been extended as far up as the Cross River, which unites with the Croton about thirteen miles from Sing Sing; perhaps a route may be found to connect the Croton with the Bronx or the Byram Rivers. But if this cannot be effected, *the Croton can be taken out at a sufficient elevation, and conducted along the bank of the Hudson River to the City.*" As I have before stated the routes which he suggests in the above remarks, were examined by him and pronounced unfavorable.

82. The reason why Mr. White was unsuccessful in his plan to unite the Croton and the Saw Mill rivers, is owing to the great height of the dividing ridge between those waters, and the lowness of the Croton valley, and to the fact that he struck the Croton river, at a point which must be more than two hundred feet below the summit of the ridge. In the commencement of the examination of the Sharon Canal Company they meet with the same difficulties with Mr. White's survey; and it was only after repeated attempts that they succeeded in finding a route, which presents great difficulties and expense, on account of the rugged character of the lands over which it passes; and in truth, those obstructions are so great, that Mr. Young the engineer, I am informed, for a long time hesitated to give an opinion on its practicability. But if that survey can be relied on, it demonstrates the fact that the

Croton and the Saw Mill valleys may be united, by taking the waters from Crawford's Mill, and continuing the works on the southern slope of the Croton river, by embankments, tunnels, and deep cuts, &c. until it enters the valley of the Ciscoe Creek.

83. The height of the dividing ridge between the Ciscoe and the Saw Mill rivers, above tide, is probably 420 feet. From a series of levels made by Mr. Cartwright of the Croton valley, and politely furnished by him, it appears that the Croton river at Pines' Bridge is 183 feet; at the Muscote Hill 207 feet; at Titicus River Bridge 247 feet; at Owen's Mill 268 feet, and at Sodom 400 feet above tide. By examining these elevations, and comparing them with the height of the ridge, we will find it is utterly hopeless to expect any other point of departure than the one fixed on by the Sharon Canal Company; or, unless we resort to very deep cutting, a long and expensive tunnel, or raise the water by machinery from the Croton River, which would be accompanied with great expense, as at the mouth of the Ciscoe, it would be necessary to elevate it four hundred feet. The levels also demonstrate what before was stated, that it is impracticable to join the Croton River either with the Wampus or the Byram Rivers, unless we resort to the same expedient, and pass into the ponds on a very elevated level.

84. The first plan presented by Mr. White, in his report of 1824, to the Hon. Stephen Allen, was to take the waters of the Bronx River, at Williams' Bridge, or at a point about one mile below, by constructing a new dam. The route as delineated on his map, commences at the first point and follows down the valley of the Bronx for about one mile; it then diverges up the outlet of a swamp for ten rods, and by a cut of forty-two rods enters the valley of the Morrissene Creek; it then pursues the west bank of that stream and to a spring brook, the valley of which it follows to a ridge of rocks which separate the Morrissene and the Mill Creek vallies. His route then passes under the ridge by a tunnel seventy-two rods in length; by an embankment the line crosses over to the west bank of the last stream; it then follows its valley, on steep side lying ground, to a reservoir, number one, in the vicinity of Macomb's Dam.

85. Mr. White makes the following remark; "The distance from Williams' Bridge is about five and a half miles, and by deducting the proposed declivity, will leave the water at the termination of the canal near Macomb's Dam, five and a half feet above the Park, and must be raised to the necessary elevation of fifty feet above the Park, which will make forty-four and a half feet to be raised by machinery."

86. Mr. White proposed to have four reservoirs, the location of number one and four have been stated, the other two are not defined in his plan. He states, that the surface of the reservoirs on the island could be raised nearly equal to number one located opposite to Macomb's Dam in West Chester, and the increased height in the reservoirs could be used in case of fires. They would also assist in relieving the friction of the 'pipes, and they would serve as a receptacle for all foreign matter which might be floating in the water. His first reservoir was to hold four millions of gallons, and the water was to be conducted into the others by mains of thirty inches, and into the Manhattan Reservoir by mains of twenty-two inches. His total estimate of the expense of number one was \$953,011.

87. Mr. White's second plan was to take the water from the Bronx in the same manner and route as the first plan to the Morristene creek: the water was then to be permitted to follow that stream, and be diverted from it on the same route and at the same point into the valley of Mill Brook: it was then to pass down that stream to a dam near Devoe's house, and a canal was to be cut for forty-five chains to the point opposite to the reservoir on the first route. On this plan the water was to be raised seventy feet. His estimate of the expense of the works was \$920,811⁵; and in conclusion, he remarks, "When we take into consideration the additional height which the water must be raised, I think the first plan has the preference."

88. In examining these two plans, we cannot but help being struck with the surprising similarity between them and the one proposed by Doctor Brown, in 1798, and Col. Robert Macomb, in 1819. And we must also say, that even his third and fourth

plan has strong features resembling those of Mr. Weston in 1799. The opinions therefore of those eminent men, as far as the practicability of the work is concerned, is most amply sustained by Mr. White's examinations.

89. His third plan was, to take the water from the Bronx at the West Chester Cotton Factory, and to introduce it into the city without resorting to machinery. The water at that point was fifty-six feet above the Park, at the City Hall; but could be increased six feet, by adding to the height of the Dam. The distance was twenty-one and a quarter miles from the Park, and the work was to have one foot fall in the mile.

90. On this plan the Sprain or Valentine's Brook lies south of the point of commencement; its waters would therefore be lost, unless it can be introduced by a dam, or a lateral cut. The route, also, makes a considerable bend, when it comes to its valley; it then follows the course of the Bronx, and in a parallel line with the same vallies and streams, and routes of number one and two. Mr. White, in speaking of this plan, says, "Water power is not as objectionable as steam, on account of the great expense of the latter; but both should be avoided if possible, in a work of so much importance to the inhabitants of the City; for if the supply should fail, on account of unavoidable or unforeseen accidents to the machinery, the consequence might be extremely calamitous, situated as they are on an Island, surrounded by salt water, and as the Wells now in use, would undoubtedly be discontinued after the introduction of good water;" on account of the difficult character of the ground, and to add to the security of his works, Mr. White proposed to construct a brick tunnel five feet diameter, and laid in hydraulic cement. He estimates the cost of the works at \$1,949,542; and he says, "the amount may appear large, but it is for a permanent work, that is to endure for ages, without a constant tax for repairs."

91. Mr. White's fourth plan, was for an open canal, on the same route; his estimate for that improvement, was \$987,535. He remarks, "for this sum the water can be delivered into the Manhattan Reservoir without machinery;" and "this plan is

much the cheapest, but whether it is the best, must be hereafter determined."

92. In connexion with the above routes, Mr. White surveyed a line from his reservoir number one to the Saw-Mill River. The route followed the east side of the ridge, which lies between the Bronx and the small creek which enters the Harlem River south of Macomb's Mill at Kingsbridge; this survey was commenced at Danger's Mill on the Saw-Mill River, and one and a quarter miles above the junction of that stream with the Hudson River. Below the line in the Saw-Mill valley there are five dams, at which hydraulic machinery is located; the length of cutting between the river and the creek is one hundred and eight rods; the length of the route is nine miles, and the mill-pond by Mr. White's levels is one hundred and three feet above tide. It is also supposed that a higher level could be maintained from the Saw-Mill River, as the route crosses many small streams within a short distance of their mouths. It also passes over a small stream, within one mile of Macomb's Dam, and within thirty-two rods of the Harlem River.

93. In 1826, Mr. White, after a careful examination of the country, and re-viewing his lines of surveys made in the year 1824, recommended to the then New-York Water Company, to commence their works, at Underhill's Bridge, which is one hundred and thirty-two feet above tide, and about two miles above Shaw's cotton factory. The water was to be conveyed in a stone or brick tunnel, (forming a closed canal) laid in hydraulic cement, as far as the Harlem River, and from thence distributed through iron pipes. The canal or tunnel was to pass along the valley of the Bronx for eight miles, and then Westerley to the Morrikena Creek, and passing along the declivity of the hills about two and a half miles; it then branched into two routes, one leading to Macomb's Dam, or Bridge, near the termination of the Third Avenue, and the other to Coles' Bridge.

94. The length of the tunnel was thirteen and a half miles, and it was to have a fall of one and a half feet in the mile. There was to be a large reservoir on the West Chester side, and the

Harlem River was to be passed by a permanent stone bridge to support the pipes, and to form a good highway. His estimate of the expense of the works was \$1,321,000, exclusive of the sum to purchase water rights on the Bronx, and to pay damages for lands used for the works. And he also says, "from the purchases already agreed to be made, it is not believed that all subsequent ones will exceed \$125,000. In 1824, it will be recollected, that Mr. White's estimate from Shaw's cotton factory, was \$1,949,542, or making a difference of \$616,542 in favor of the last plan.

95. From the observations of Mr. Weston, and the surveys of Mr. White, and the location of the Sharon Canal by Mr. Young, it would appear that there existed difficulties; but it was practicable to conduct the water of the Bronx on a sufficient elevation to supply the City, without resorting to machinery at the Harlem River. But it appears from a recent examination and survey made by Mr. Dewey and Mr. Serrell under the direction of Judge Wright, that considerable doubts exist on this subject. Those gentlemen, in a report made in November last, say, "that on proceeding from Macomb's Dam, upon the high land above, and examining for a spot of Table land, one hundred and twenty feet, containing three or four acres, and capable of being made a reservoir, no such spot could be found nearer than about one and three quarter miles from the starting point. The distance between that and Macomb's Dam, is over a very rugged line mostly of stratified gneiss rocks, dipping to the west, and interspersed with hollows, requiring considerable embankments to maintain the line of a tunnel or open canal, but not any where offering facilities of earth, or other materials fit to aid in making such embankments."

"From this point, the country for near two miles is tolerably open, and such as does not offer any extraordinary difficulties in the formation of a canal or tunnel; continuing the level and entering the valley of the Bronx on the west side, the required line could only be obtained upon the face of immense rocky bluffs, separated by deep ravines, without any supply of earth, or other materials, within any reasonable distance; and this character of

country continues with little variation, till about a quarter of a mile above Underhill's Bridge, where the land becomes so exceedingly abrupt and high, that it became requisite to cross to the eastern bank of the stream, before the work of running the level could be continued; the level struck the Bronx at about one hundred and thirty-six feet above tide, near Major Popham's Mill, in Scarsdale, about sixteen miles from Macomb's Dam."

"From the character of the country it may be stated, that a safe open canal, or closed tunnel descending one foot in the mile, from a point on the Bronx, so as to arrive on the high land near Macomb's Dam, at an elevation of one hundred and twenty feet above tide, is wholly impracticable."

96. One of the most important facts of the whole subject is the quantity and the permanency of the supply of water. I shall therefore enter into a careful investigation of that subject, and shall present to your consideration, the guages made by General Swift, Canvass White, George W. Cartwright, and Messrs Dewey and Serrell, and with the capacity and location of different reservoirs proposed by these gentlemen. The erroneousness of the views taken of the *quantity of water* in the reports of Dr. Brown and Mr. Weston being palpable, it must be unnecessary to introduce them here.

97. Mr. White, in his report in 1824, says, "No extraordinary drought has occurred since I have been engaged with the examinations, that would enable me to gauge the streams when yielding the least quantity of water; but I think sufficient allowances have been made for dry seasons." He also observes, in his report of 1826; "The long drought of the past season has been favorable for guaging the streams, and ascertaining the quantity of water that may be depended on during similar seasons."

98. In a report made in April, 1822, by a special committee of the Common Council, consisting of Messrs Allen, Hammond, Wyckoff, and Mead, they say, "That Mr. Canvass White, at their request, made an actual estimate of the quantity of water flowing from the Rye Ponds, which appears was equal to about one million of gallons of water in a day; that they had ascer-

tained that the ponds were never lower than at the time; and that by raising a dam at the outlet of the lake, any given quantity could be contained for the use of the city."

99. In September, 1819, the outlet of the little Rye Pond was guaged by General Swift, in the presence of C. D. Colden, Doctor Mitchell, and others, and by his measurements, it furnished less than 2,779,920 gallons in a day. The ponds were then considered moderately low, but not as low as they sometimes were.

100. It appears by the report of Messrs. Dewey and Serrell, in November, this year, that they also made several guages; and they have likewise submitted several calculations on the drainage of the country and the fall of rains, and the capacity and supply of the reservoirs. But it must be a matter of extreme regret to all, that their measurements, instead of confirming the labors of their predecessors, throw much perplexity on the whole subject, and unless we suppose they have guaged the streams after heavy falls of rain, we can assign no satisfactory reasons for the great difference between their statements and those of others.

101. The three guages made of the outlet of Rye Pond appear to be as follows: in 1819, by General Swift, 2,779,920 gallons; by Mr. White, in 1822, 1,000,000 of gallons; by Messrs. Dewey and Serrell, 4,173,000 gallons.

102. The quantity of water which Mr. White stated as being available to his works, in 1824, and in twenty-four hours, and allowing a drought for six months, was as follows:

| | | |
|---------------------------|-----------|---------|
| From Bronx River,..... | 3,000,000 | gallons |
| Rye Ponds Reservoir,..... | 3,600,000 | " |
| Byram River,..... | 2,000,000 | " |
| Saw-Mill River,..... | 2,000,000 | " |
| Saw-Mill Reservoirs,..... | 1,000,000 | " |
| <hr/> | | |
| 11,600,000 | | |
| <hr/> | | |

In speaking of the Saw-Mill River, in 1826, Mr. White says, "in guaging the stream, it was found to be so reduced in consequence of the drought, that no reliance can be placed on it for

any part of the supply." He also abandons his plan of taking the Byram River direct into his works at Rye Pond, and proposes "to cut a small independent canal so as to divert the reserved waters only, thereby avoiding any interference with the water rights and mills on the Byram River. If we deduct the waters of the Saw-Mill River from the above, it would leave the daily supply 8,600,000 gallons per day.

103. In 1826, he placed the quantity as follows per day, with a drought of six months.

| | | |
|--------------------------|-----------|---------|
| Bronx River,..... | 4,302,720 | gallons |
| Rye Pond Reservoir,..... | 4,798,000 | " |
| Byram Pond,..... | 4,335,164 | " |
| <hr/> | | |
| 13,435,884 | | |
| <hr/> | | |

By this calculation it appears that the supply of running water in the Bronx, had considerably increased in 1826 by 1,300,000 gallons; but the total quantity of running water stated by Mr. White, was nearly 3,000,000 of gallons greater in 1824, than at the present time. The reservoirs had also been increased very much in capacity.

104. The calculation of the supply of water as ascertained by Messrs. Dewey and Serrell, with a six month's drought is as follows :

| | |
|---|-----------------|
| | <i>Gallons.</i> |
| Bronx River, at outlet of Little Rye Pond,..... | 4,173,000 |
| Big Rye Pond Reservoir,..... | 4,523,539 |
| Byram River,..... | 13,571,000 |
| Byram Pond,..... | 2,756,191 |
| Wampus Pond,..... | 631,627 |
| Ciscoe Pond,..... | 7,895,340 |
| <hr/> | |
| 33,549,597 | |
| <hr/> | |

105. Of this quantity, there is 17,744,000 gallons of running water, and 15,805,597 gallons to be stored in reservoirs; and if

we compare it with Mr. White's calculation in 1826, and deduct 8,527,617 gallons for the Ciscoe and Wampus Ponds Reservoirs, which he did not embrace in his estimates, it makes the above calculation 11,586,696 gallons greater than his amount of water. There is also 13,441,280 gallons more of running water, than Mr. White made in 1826, and the volume of the Byram River has swelled from 2,000,000 of gallons, its minimum discharge, to 13,571,000 gallons. It must also be remarked, that Mr. Dewey's reservoir in Rye Pond, falls 274,461 gallons short of the quantity stated by Mr. White in 1826, although he raises the pond four feet higher than the other, and his quantity exceeds his calculation of 1824, 923,539 gallons. It is true, that the ponds that year, were only to be raised eight feet. There is a difference also in the calculations in the areas of the reservoirs of twenty acres. It must also be remarked, that the capacity of the Byram Pond Reservoir is short of Mr. White's quantity by 1,577,973 gallons, and the Byram and the Wampus Reservoirs united, fall short of Mr. White's Byram Pond Reservoir, 946,346 gallons. I must leave it to your Committee to reconcile the conflicting calculations of those gentlemen.

106. The Ciscoe Reservoir, as introduced by Messrs. Dewey and Serrell, is a new storing point, named by them, and I believe never contemplated before. Mr. Dewey says, "I then proceeded up the valley of the Ciscoe, which discharges its waters into the Croton near Pine's Bridge. This river has its main source in a large pond in an extensive valley, at the outlet of which are Kuby's Mills." "By raising the dam at the outlet seven feet, I am assured by the proprietor, that one thousand acres can be ponded, and the water will flow near to the north easterly side of Wampus Pond. I assume then, five hundred acres only may be overflowed, and all low wet land of little value. It would thus appear, that the owner of the Mills conjectured the number of acres, and Mr. Dewey reduces it one half. He also says, "that the waters of the Ciscoe can be connected with the east branch of the Saw-Mill River by a canal or tunnel of about two and a half miles in length. The ground is favorable; but one deep cut will be necessary, about six hundred feet long, and twenty feet deep." But after the wa-

ter is once in the Saw-Mill Valley, it requires another cut and a dam, or the continuation of the works from the Ciscoe Pond to the Bronx River, which on the whole must increase the hazard and expense of its introduction. How much easier, in all senses, would it be to let this water pass into the Croton Valley, through its natural outlet, instead of attempting to divert it into new channels.

107. How much water could be procured from the Croton River Valley by continuing a work to the east branch, I have no means to determine. It is however certain, that the expense of that operation would be very great, and the supply of water comparatively small, as the route would cross all the streams a great way above their mouths. This plan would also be very destructive to mill property, and hydraulic sites.

108. It is evident if we should extend our works to the Rye Ponds, we should cut off a very considerable supply of water from other branches and springs of the Bronx River. And if we should go to any point on the stream below Underhill's Bridge, we would have to resort to machinery to raise the water at the Harlem River, to carry it to the elevated parts of the City and the Island. If we agree that the last plan recommended by Mr. White, would be the proper course, our supply from the Bronx and the Byram Rivers would be as follows. By taking the minimum calculations of Mr. White, and those of Messrs. Dewey and Serrell, and rejecting the running waters of the Byram River, which Mr. White has shown we could not take, unless we destroyed immense hydraulic privileges and machinery.

| | |
|---------------------------------|--------------------|
| Bronx River running water,..... | 4,302,720 gallons, |
| Rye Ponds Reservoirs,..... | 4,798,000 “ |
| Byram Pond Reservoir,..... | 2,756,191 “ |
| Wampus Pond Reservoir,..... | 631,627 “ |

Quantity of water in 24 hours,.....12,488,538

109. But you may inquire, why I have not included the Ciscoe and the Croton Rivers. To this I must reply, by stating, that it

would be much easier to take those waters at Pine's Bridge, than to turn them into the valley of the Bronx; and it must be apparent, that although it may cost many hundreds of thousands of dollars to mingle them to together with the latter, that in the Croton Valley, they are free offerings of Nature, without resorting to artificial works to obtain them.

110. The above summary is a favorable view of the quantity of water; but it now becomes necessary to inquire if we could with safety calculate on the whole amount. Suppose our low stage of water should continue more than six months, or that any misfortune should happen to the bulkheads at the outlets of the Ponds, or derangement in the pipes, or any other parts of the work, or that there should be a great loss of water during a drought, by breakage, &c. I would inquire, in what manner we could augment our supply, until the Autumnal or Spring rains set in? These are contingencies that may happen; and what I now propose to examine, is the evaporation on the reservoir and the loss of water which will take place in its flow from the reservoirs to the canal or tunnel at Underhill's Bridge.

111. You must be aware of the nature of the artificial reservoirs which are to be created in the ponds. They are to be filled with water when the streams are full, and to be drawn off when the natural supply of the Bronx is not equal to the consumption of the City. When the Bronx is thus low, and its branches and channels almost dry, the sluices are to be opened in the bulkheads of the reservoirs and their waters permitted to pass down, until they reach the dam at Underhill's Bridge: it is then turned into the canal or tunnel, and conducted to the City for its uses. At the time that the water will be drawn from the reservoirs, the consumption will be the greatest in the city, owing to its dusty condition, to cleanse the streets and to purify the air. There will also be a diurnal loss of water, proceeding from the evaporation from the surface of the reservoirs, and from the loss of the water flowing through the sluices of the reservoirs until it enters the pipes on the island, and the absorptions of the soils through which it passes. I suppose that this loss will be equal to a depth of two

feet on the surface of the reservoirs, and to a column of water in its passage from each reservoir equal to four feet in depth and fifteen feet wide, for the time that the reservoirs would be required to be used, say six months in the year. On an acre of pond the annual evaporation would be 162,926 gallons, or 895 gallons would be lost on an average daily for 182 days. In a mile of channel the annual loss would be 296,228 gallons, and in the same period with the other, 1,633 gallons per day. This calculation would not properly apply to the works leading to Underhill's Bridge; in which section the loss would be much less. If we suppose it equal to two feet in depth, it gives 815 gallons in each mile of its length.

| | <i>Gallons.</i> |
|--|-----------------|
| The distance to Underhill's Bridge from Macomb's Dam, 13½ miles ✕ 815 gallons | 11,102 |
| From Underhill's Bridge to reservoir's outlet of Rye Ponds, 12½ miles ✕ 1,633 gallons | 20,412 |
| Surface of Rye Ponds Reservoirs, 245 acres ✕ 895 gal- lons | 219,275 |
| From Underhill's Bridge to Byram Pond Reservoir 19½ miles ✕ 1,633 gallons | 31,843 |
| Surface of Byram Pond Reservoir, 120 acres ✕ 895 gal- lons..... | 107,400 |
| From Underhill's Bridge to Wampus Pond Reservoir 19½ miles ✕ 1,633 gallons | 31,843 |
| Surface of Wampus Pond Reservoir, 55 acres ✕ 895 gallons..... | 49,225 |
| | <hr/> |
| Total loss by evaporation, soakage, &c. | 471,100 |
| | <hr/> |

If we subtract this from 12,488,538 gallons, it leaves us a certain quantity of 12,017,438 gallons, unless in case of an accident occurring to the works.

112. It may appear strange to some of your Committee, that the minimum flow of water is taken as the criterion to predicate our calculations on; but if, for instance, our consumption should be more,

and we should take any quantity above the smallest volume of the stream, it is plain, the moment it fell below the required quantity, we should have to draw from the reservoirs, or they would have to make up the deficiency in the supply ; and therefore, although the stream at certain periods might yield ten times the quantity we required, if we had no means to collect those waters, they would not in the remotest degree assist us, when it fell below the quantity we consumed.

113. It must also be recollected, that although we have by the assistance of reservoirs, swelled our quantity to 12,027,438 gallons, and we have only 4,312,720 gallons of running water, on which we can depend in case of accidents to the reservoirs. It has been suggested, that this quantity may be increased by constructing reservoirs in the valley of the Broux. It is true, that dams could be built, and ponds formed, but they would all be shallow, owing to the rapidity with which the bed of the stream rises. Those dams would also necessarily be high, for if *low*, the capacity of the pond will be small ; the expense of their construction, and the risk of their maintenance would therefore be increased, and the damage to private property be very great ; and if it should unfortunately happen that one of the dams should be swept off by ice or by floods, its fragments and the water collected in the pond might sweep off the whole of the lower works. Accidents of a similar nature, annually happen on most of all our mill streams.

114. Mr. White in his report in 1824, says, "It has been ascertained by experiments made at Philadelphia, that twenty-seven gallons per day for each person, is sufficient for the demands in summer, and this includes the amount used for all purposes of manufacturing for brewers, tanners, livery-stables, and for washing the gutters, &c." In 1826, he allowed twenty gallons on an average throughout the year, and I am perfectly satisfied of the correctness of the data, as it agrees with some investigations I have made of the quantity of water consumed in other cities.

115. It must be recollected, that we cannot increase the supply of running water in the valley of the Bronx, unless we commit great mischief to the country, and pay immense damages for hy-

draulic works. Our only course on that route, is, therefore, to resort to the valley of the Croton. This plan must be attended with great difficulties and expense ; for to secure it, we have to construct a continuous line of works, sixty-two and a quarter miles in length, between the City-Hall and the east branch of the Croton River.

116. Mr. White states in his report of 1826, that the running water in the Bronx was equal to a supply for 215,130 persons, which is below the present population of the city. If we [add to this the Rye Ponds, and the Byram and the Wampus Reservoirs, it would be equal to a supply for 600,000 people, and will be sufficient to provide for the demands of the City for twenty-five or twenty-eight years to come ; after that period, we must resort to the Croton River. I now therefore propose to examine, if it is not better to do it at this time, than to postpone it to a later period.

117. If we turn our eye to the plan recommended by Mr. White in 1826, to secure the supply of water from the Bronx, we find it necessary to construct a canal or tunnel, through a very difficult and expensive country to Underhill's Bridge. The distance is thirteen and a half miles. At that point it would be necessary to construct a dam, and sluices, gates, &c. ; at the Rye Ponds, 34 miles from the city, we also find another dam, sluices, &c., following the line to Byram Pond, a canal or close tunnel would have to be constructed seven miles in length, and a branch of the Wampus Pond, three miles more ; and at the outlets of each of those ponds, dams and sluices would also have to be provided. Those ponds are forty-one miles from the City Hall, as measured on the route of the work. We have, therefore, twenty-three and a half miles of canal, four dams, and four sets of sluices, besides overflowing and destroying much land, and paying great damages for diverting and using the waters. The expense of all these works, and unavoidable damages to property, must be very great, and the cost of their maintenance and superintendance equally so. A question more serious presents itself, in relation to diverting the waters of the Byram and Wampus Ponds into Rye Pond reservoir. Those Ponds lay at the head of a stream which flows through the State of Connecticut ; and

it is questionable at least, if we could change those waters from their channels, without first obtaining the sanction of that State.

118. In a former part of my communication, I have given a detailed account of the Croton Valley, and its tributaries, and also the elevations of the stream, as furnished by Mr. Cartwright. I shall now present his guages of the Main Valley, and many of its branches. "The east branch of the Croton River, above Milltown, on the 16th of October, 1822, discharged 5,356,800 gallons of water in twenty-four hours; but that stream, in a very dry season, has been known to run through an aperture seven inches square. The west branch of the Croton, at its entrance in West Chester, on the 25th of July, 1825, emitted 12,500,000 gallons. The Mahapook Pond 2,000,000 gallons, and the Mountain Pound 588,300 gallons, guaged 30th of August, 1825. In the Croton River at Pine's Bridge, there is never less than 20,000,000 of gallons of water passing in every twenty-four hours." The river at this point is therefore capable of supplying one million of people, allowing a consumption of twenty gallons to each person. This supply can be augmented by constructing reservoirs, and we have seen by Mr. Dewey's statement, that one reservoir could be constructed which would supply more than seven millions of gallons per day, within a few miles of Pine's Bridge. But if it were necessary, more than seven thousand acres could be ponded, and the water raised from six to sixteen feet on it; and also other supplies could be obtained, as I have before stated in alluding to the Sharon Canal route, and the east branch of the Croton River. This supply may, therefore, be considered as inexhaustible, as it is not at all probable that the City will ever require more than it can provide. The character of the waters at Pine's Bridge, I have no hesitation in saying, is equal to the Bronx at Underhill's Bridge.

119. The elevation at Pine's Bridge by Mr. Cartwright's measurement, is 183 feet above tide. I would propose at this point to sink the bottom of the works below the bed of the stream, to avoid the risks of a dam, and more fully to command the whole volume of water, if necessary. Sluices with gates should be provided, and also other contrivances to prevent any impurities from the stream passing into the works.

120. From Pine's Bridge the route would follow the elevated and broken banks of the Croton, until it intersected the bank of the Hudson River. It would then continue on the rugged slope of the lands in the vicinity of that stream to Tarrytown, about eleven miles from the point of commencement. In this distance it would be necessary to cross the Valley of Sleepy Hollow, and several considerable ravines, and gulfs formed by springs and brooks. The route would have to be conducted meanderingly round them; or they may be crossed in a straight line by embankments, pipes or aqueducts. From Tarrytown the ground may be considered favorable, although principally a steep side hill to the mouth of the Saw-Mill River, a total distance of twenty miles. From the Saw-Mill River, the route could either follow the northern bank of the stream to Danger's Mill, a distance of one and a quarter miles, and continue on, or in the vicinity of the route surveyed to Macomb's dam, by Mr. White, a distance of nine miles, and there cross the Harlem River; or it would cross near the mouth of the Saw-Mill River, and follow the bank of the Hudson to the Harlem River, and cross that stream a short distance above its mouth, and reach on the opposite side very rocky, narrow, and elevated ground laying, directly on the banks of the Hudson River. This ridge is broken in a short distance in its continuation south, by a ravine, or hollow, which crosses the road to King's Bridge, near Crawford's tavern. The line would be forced to pass over it, to reach the elevated lands in the vicinity of Fort Washington; and the first reservoir on the Island would be constructed near Madam Jumel's. The other reservoirs ought to be placed on the elevated ground on different parts of the Island. The distance from the Saw-Mill to the Harlem River, is about six miles, and from that stream to the reservoir is four miles, making the whole length of the route thirty miles to Madam Jumel's, and the one to Macomb's dam is thirty miles and a quarter.

121. I must say, that the routes present great, but not insurmountable impediments. In some places the works may be very expensive, and in others very cheap; and I have seen nothing in the character of the routes, but what perseverance and skill can overcome. It will, however be necessary, that a minute and care-

ful survey should be made, to determine fully the difficulties of construction. The expense of the work will also, in a great degree, depend on the plan of crossing the vallies, some of which are wide and deep. Many modes ought to be examined; such as stone, wood, and iron arches, supporting pipes or elevated and open aqueducts; low and high embankments supporting pipes, or the embankments being sufficiently elevated to conduct the works over, without depressing them more than the required fall; and also carrying the works circuitously around the vallies, and other matters connected with the construction of the works.

122. The elevation of the Croton at Pine's Bridge being 183 feet, and the bottom of the work being sunk six feet below the bed of the river, it leaves 177 feet; and if the line from that point should descend uniformly one and a half feet in the mile, the Saw-Mill River, on the first route, would be crossed at Danger's Mill, at an elevation of $42\frac{1}{4}$ feet above that stream. On the lower route it would require, at the mouth of the Saw-Mill River, a work 147 feet high. At the Harlem River, on either of the routes an aqueduct 138 feet high and 1000 feet long; and over the low ravine at Crawford's Tavern, a work 115 feet in height. It is apparent that these elevations could be reduced by resorting to pipes sustained on low arches, instead of the open aqueduct. This plan would, however, much depress the heights of the reservoirs on the Island, on account of the friction in the pipes. It is true, a higher starting point on the Croton could be obtained, which would, perhaps obviate all fears on that subject. But it remains to be seen if that would be the most economical plan. These facts cannot be settled, and the height that the water from the Croton can be delivered on the Island, must remain in some doubt until after an actual survey. I have, however, strong confidence in the practicability of delivering it at 138 feet above tide, and it would admit of the bottom of the reservoir being 120 feet, provided it was 18 feet in depth.

123. It must be recollected, that although the elevations of the aqueducts would be very great, to continue the works with an uniform descent from the Croton, they would not be as expensive as a canal aqueduct, or as a public stone, or iron arched bridge; for

although the lower parts of the piers would require solidity for the first twenty or thirty feet, to withstand the pressure of the stream and floating masses which would impinge against it. All the work above that point, need not possess greater strength than to sustain the thrust of the arches, and the weight of materials, and of the water in the trunk of the work. The stone to be used would be West Chester marble and granite, both of which are convenient to the works.

124. If a medium level should have to be resorted to, on account of unforeseen difficulties in the execution of the work ; the water would then have to be elevated by machinery on the Island, at the Harlem River. In such a contingency, you have the tide power of that stream, the waters of the Bronx, on Doctor Brown's plan, and steam engines. All these modes require careful investigations to determine which is the best. If, however, the water could be introduced on the Island, so as to supply parts of the City, it might be raised by steam engines, situated at the reservoirs, to the more elevated sections.

125. The reservoirs ought to have capacity to contain a supply of water sufficient for the consumption of the City for many days, so as to have a quantity on hand to provide against any misfortune happening to the works. These reservoirs ought not to be confined to the Island, but several should be located in West Chester ; and many of the vallies on the route are admirably calculated for that purpose. There will also be other benefits resulting from this system of reservoirs, which you must plainly see.

126. It appears that many advantages are possessed by the Croton plan over the Bronx. 1st. In its supply of running water, which is five times greater than in the latter. 2d. In the capacity of its reservoirs, which are seventeen times greater. 3d. In the security of the works and expense of superintendence, as it requires no dams and but one set of sluices ; while the latter requires four dams and four sets of sluices. 4th. In the little injury it does to hydraulic works and private property, compared with the Bronx plan. 5th. The route also passes through a country which can never, from its character, be densely populated or

much cultivated; while the other route passes through a rich country, susceptible of a dense population; and if we include the whole extent of necessary canals or tunnels to obtain the full supply from the Bronx River with the plan of the Croton, the difference in the extent of the construction of the canal, is only six and one half miles in favor of the former. The Croton River requires a continuous work to introduce it on the Island; while the latter will be constructed in detached pieces. The waters of the Croton are, however, three miles nearer the City-Hall than those of the Byram or Wampus Ponds. And there can be no question, that the waters of the Croton, when delivered on the Island, after passing through its continuous and neat channel, will be much purer than those of the Rye, and Byram, and Wampus Ponds, which would flow, for a great part of their distances, through the natural channels of the Bronx, and become contaminated, by mixing with inferior waters and other impurities, in their descent to Underhill's Bridge.

127. It may be urged, that it would not be necessary for some years to come, to go beyond the Rye Ponds. It must, however, be recollected, that although it may not be necessary to construct immediately the canal and bulkheads at the Byram and Wampus Ponds, that prudence would call upon us to do it, to provide a supply of water, in case of any accident happening to the Rye Ponds Reservoir; and it would also be necessary immediately to secure those ponds, and the lands bordering on them. Therefore, our plans and estimates would have to include at this time, all those items.

128. Various plans have been suggested to bring the water to the City. On a full examination, I am clearly of opinion, that it would be the best to introduce it through an open canal; that mode being the most economical, the most secure, and permitting the greatest quantity of water to flow through it at equal spaces of time; and the attainment of a greater head for our Reservoirs.

129. An open canal has been seriously objected to on account of ice forming in the winter on its surface. To avoid this, it

must be made narrow and deep, and direct ; and the fall being eighteen inches in the mile, will cause a rapid current on its surface. If this should be found in very severe winters to be insufficient, the discharge-gates on the line must be opened to quicken the current ; and the sluices on the Croton must pass into the works a larger quantity of water than usual, or by passing through the sluices a larger and a smaller quantity, thereby creating a rapid alternate rise and fall of the level of the surface of the canal. Mechanical contrivances could also be resorted to, to break the ice and keep it open ; the floating ice, if any, could easily be removed by labourers employed for that purpose. It is also evident, that although the canal may freeze over, if we take that subject, into calculation, we can pass a sufficient quantity of water under the ice for the supply of the City, by giving it depth. It is also apparent, that at the time of ice, the consumption of the City will be less than at any other periods of the year, as water will not be required for the streets, yards, &c.

130. It is said, that the water flowing in the canal, would become adulterated by the washings of the surrounding lands, and also that bars and shallows would form in the work. This objection would be tenable, if the works are badly built, or the plan of constructions are not well considered. It is, however, an easy matter to exclude the rains and wash, which would run from the hills by digging drains, and providing suitable passages under the works to pass it away. My time will not permit me to enter into a full detail, as it will require different modes of construction to apply to different situated grounds. In respect to the permanency of the plan, there can be no doubt, as on side hill, the canal must be cut the full breadth of the water line in them, and on the embankments stone walls or thin iron plates can be resorted to, as the former will have to be the whole extent of the works.

131. A closed tunnel, as proposed by Mr. White, is very objectionable, on account of the expense of its execution, and the danger of leakage or breakage. If an accident of this nature should happen in the Winter, it would be impossible to repair it as

cement will not set in frosty weather. The work would also be weak at the different angles made in the route, and the velocity of the water would be very much retarded by friction and collisions with the different crooks in the line. It must, also be recollected that the strength of the arch is its downward pressure, and the head of water is applied under it, thereby tending to thrust it out upwards, and nothing but the adhesion of the cement and the filling above the arch will prevent it from bursting. Other reasons could also be assigned.

132. Pipes are also to be objected to, on account of the great expense of procuring and laying them, as it would require pipes of thirty inch diameter, and the friction of the water, in its passage through them, would not only render a greater head necessary to overcome it, but it would diminish the quantity delivered on the Island, and also the height of the reservoir. If pipes, or a tunnel was adopted to provide against accidents, it would require a double line for each.

133. Many persons have suggested that the water in the open canal, by its passage through it, would become impure; I cannot see the force of the objection, as I have already stated the manner that those impurities can be avoided. It must also be recollected that the principal supply of the city of London is procured from the New River and the River Lea, by the means of an open canal. The canal, to maintain its level, meanders a distance of thirty-nine miles, although the source of supply in a direct line, is not more than twenty miles from the city. Those united streams supply 28,774,000 gallons in twenty-four hours, and provide for 177,400 houses. In 1816, there was on the canal, forty-three sluices, and 215 public bridges over it. There are also several subterraneous passages under roads; one is two hundred yards long. At Islington the canal is fourteen and a half feet wide, and four and a half feet deep. From the New River head reservoir, which is fifty-eight feet above the River Thames, the water is raised thirty-five feet by steam engines, into two reservoirs. One is situated near Pentonville, and the other near Tottenham Court-House road. They each contain five acres, and are ten feet in depth.

134. On the north-west side of London Bridge there are five water-wheels, which raise the water one hundred and fifty feet high from the River Thames in a reservoir, for the use of the city. It must be well known that the Thames River is the receptacle, not only for the whole filth of the city of London, but of its shipping, and of the villages and towns on its borders; and yet it is an indisputable fact that it is not only considered good by its citizens, but that many of the packets and vessels from this city supply themselves for their trip from that source, preferring those waters to ours. Part of the city of Paris is likewise supplied with the waters of the Seine, and the more elevated parts of the city from springs which rise on the surrounding eminences. The water works of the city of Edinburgh are too well known to require to be mentioned.

135. It is well known that the city of Philadelphia is supplied with water procured from the River Schuylkill, and raised by hydraulic machinery, on Fair Mount; that the stream rises in and flows through one of the richest mineral regions of our country; its valley is filled with villages, manufactories, and farm houses; its lands are arable and cultivated to their fullest extent; its currents are slackened by numerous dams; many public roads are in its vicinity; it is crossed by numerous public ferries and bridges, and there is a navigable canal in constant use, while the season permits, from one end of its valley to the other. Yet with all these facts, which would be objections in the minds of the fastidious, those waters are not only considered wholesome and palatable, but are the pride and just boast of that city.

136. The vessels which navigate the Hudson River, to this day, freely use its water above Poughkeepsie. The Delaware waters are likewise used, and many of the citizens of New Orleans use those of the Mississippi. At the City of Savannah, shipping supply themselves from the Savannah River, and give it preference over any other. The waters of those last streams, not only pass through swamps and receive the stagnant waters from Cypress ponds and Laurel thicket, but their currents are sluggish, and they

are contaminated with many impurities ; and yet, when they have time to settle, they are not only palatable, but pure. If we candidly take all these facts into consideration, we *must be under no apprehensions on the subject of the purity of the Croton River waters.*

137. The expense of distributing the water throughout the City, cannot be accurately ascertained, until the height of the reservoir, and the distance that the water has to run from it, are known, those are questions which ought now be determined, to find the diameters of the mains and the cross branches, otherwise it may be found, when it is too late to remedy the evil, that the city have expended more money than necessary ; or that pipes are not sufficient to provide for the consumption ; for the more elevated the reservoirs are, and the more systematical their levels are maintained, and the nearer they are to the place of distribution, the greater will be the saving on the conduits and branches. These are considerations of great consequence, and cannot be determined too soon.

138. The City of Philadelphia, before the adoption of their present plan, expended, in futile experiments and expedients, more than one million of dollars. This, on the part of our City, may be avoided, by having careful and accurate surveys made of all the difficulties of the undertaking, and a definite plan to work on, and by employing a careful and intelligent agent to collect practical information, not only in this country, but in Europe.

139. From the best opinion I can form, I am satisfied, that the waters of the Croton River may be taken at Pine's Bridge, and delivered on the Island, for a sum not exceeding \$750,000, in an open canal, and with stone linings, ditching, and walls, and including damages and other contingencies, it may swell the cost to \$850,000. The expense of distribution and reservoirs on the Island, may amount to \$1,650,000 more, which would make the whole cost of the work \$2,500,000.

140. Having thus placed the whole subject, in compliance with your wishes, in full view before you, nothing now remains to be investigated, but the probable revenue, and the advantages which would accrue to the city from the construction of the works.

141. It is admitted by all that an ample and pure supply of water is one of the greatest blessings which can be conferred on a dense community ; as it is one of the greatest conservators of public health and morals ; as it is necessary for cleanness in our houses, yards, sewers, and streets ; also for culinary and other domestic purposes, and for public baths, stables, manufactories, and vessels ; for purifying the air in summer, for embellishments in public squares, gardens, and private residences, the extinguishment of fires, and, if secured in sufficient quantities, it could be used for dry docks and other valuable City objects.

142. The advantages of the City Reservoir in the extinguishment of fires, I have before mentioned in another part of this communication. It appears in a table now before me, that the destruction of property occurring to this City by fires, from 1825 to 1829, amounted to \$1,753,633, and the average for those five years, is over \$350,000. The expense of supporting the Fire Department by the City, for the same period, amounts to \$73,627, or over on an average, \$14,700 per annum ; and during this period, there were four hundred and forty-three fires.

143. The cost of supporting the Fire Department by the City, varies considerably. In 1830, the expense amounted to \$22,962 ; the actual number of fires that happened in that year, were one hundred and nineteen, and the false alarms were one hundred and twenty-five, and the loss of property amounts to \$157,135. In 1831, the expenses of the Department amount to \$12,984, and during the three first quarters of this year, to \$13,981. On an average, it may be estimated at \$18,000 per annum. This sum, however, includes only the expense defrayed by the City, and not the services of the firemen. This item embraces a new subject of investigation, as it is well known, that the equivalent a fireman receives for his seven years' services, is an exemption from militia and jury duties ; and although those services are rendered, they still are a *tax* on the individual.

144. Another serious consideration presents itself. The time may come, when our militia laws may be very much modified, or entirely repealed. In this case, the City will have to bear the

whole expense of the Department, unless some new equivalent is granted to the firemen. To ascertain what the amount of the expense, in such a contingency would be, I addressed a note to Mr. Wenman, who says, "Our Common Council would be under the necessity of doing as they do in London and in Paris, that is, of paying a sufficient number of able bodied men to take charge of the Fire Department; in that case, it would be necessary to have under pay twelve hundred men, that being the least number it would take to manage the Engines, Hooks and Ladders, and Hose Carts. If we say one dollar per man, for every actual fire, the average number which, is one hundred and twenty-five annually, it would make \$150,000; and for every alarm of fire, there should be fifty cents allowed to each fireman for attending; and if there was only one and a half alarms to each fire, it would amount annually to \$112,000. For contingent expenses, such as washing the engines and implements, and drying hose, which in the Summer season takes one day, and in the Fall and Winter two days, besides overhauling and repairing machinery, \$40,000, it would make the total expense of maintaining the Fire Department to the City, \$312,500. These difficulties, I am certain will all be obviated, and the above sum saved to the City, provided our Common Council will provide throughout our City, a sufficient supply of water for the extinguishment of fires."

145. From the calculations of Mr. Wenman, a very important fact is developed; that although it only costs the City Council at this time about \$18,000 to maintain the Fire Department, the individual firemen are taxed in their services \$284,500 annually. It is true, their labours are rendered voluntarily, and they have an equivalent; but it does not render it less imperative on the City authorities, as the common guardian of this great community, to diminish the labours and personal exposures and risks of that meritorious, skilful, and patriotic class of citizens.

146. By introducing a copious supply of water into the city, it will diminish the risk of fire, and the rates of insurance on all descriptions of property, as it will provide the means always at hand for their speedy extinguishment; it will also prevent the spreading

of fires in times of high winds, or great drought, as the water can be thrown from the fire plugs in great quantity and velocity on the exterior ; and also with facility in the interior of the building, and on the roofs of the adjoining houses. It is self evident that as we lessen the chances of those calamities, the prices of insurance will fall. This saving has been estimated at fifty thousand dollars.

147. It is well known, that until this year, the occupants of buildings, and the owners of lots, have been required to collect the filth and dirt before them in heaps, at stated periods, to be removed by dirt carts employed by the city. This trial on the part of the city authorities, may be considered as an experiment, and its success must encourage them to persevere, or to discontinue it at their option. But whether this service is rendered in labor, or a *dirt tax* is levied indirectly on the lessee or owner of the property, it amounts precisely to the same thing. In a table now before me, compiled from the Tax Book of 1832, it appears that there are 20,944 buildings, and 9,312 vacant lots, in fourteen Wards of the city ; or, 30,246, exclusive of buildings and lots, in the Twelfth Ward. If only twelve sweepings are necessary in the year, opposite to each lot and building, and should cost twenty-five cents, it amounts to 30,738 dollars. If we add to this sum the expense of cleansing the public squares, sewers, and markets, by the city, \$20,000, it makes \$110,738.

148. When our streets become dusty in summer, and our atmosphere warm, in many of our principal streets, our citizens, to increase their comfort, and our merchants, to prevent their goods from being damaged by the dust, employ drays to sprinkle the streets with water. This water is generally procured from the East or the North River, and is supposed by many persons, to increase, instead of diminishing, the impurity of the atmosphere. The precise sum cannot be accurately ascertained, but it is believed, from the best information, that it varies between 6 and \$10,000 annually.

149. To maintain the pumps and wells is an annual tax on the city, and on its citizens. From the 14th of May, 1821, to the 26th of November, 1832, the cost to the city amounts to \$30,863. If we,

however, suppose that the cost hereafter will not exceed that of 1831, the annual tax on the City Treasury will be \$3,115, and will be lower than the amount paid for the same object in 1826 and 1829. If to this we add the expense of supporting and constructing private cisterns, pumps, wells, and reservoirs, which I am assured does not fall below \$15,123, it makes the total cost \$18,238 for maintaining them.

150. All these objects are legitimate subjects connected with our inquiry of the advantages and expense of introducing water into the city ; and I now shall examine into the probable saving which will result to the city on those items.

| | |
|---|---------|
| 151. The cost of maintaining the fire department to the City, is \$18,000 annually, suppose saving one-half,..... | \$9,000 |
| Loss accruing to the City by Fire in 1830, \$157,135, suppose saving on this item one-half,..... | 78,576 |
| Personal Tax paid by Firemen, equal to \$284,500, suppose a saving of one fourth,..... | 71,125 |
| Saving on account of property insured against fires in the City,..... | 50,000 |
| Amount paid for cleaning streets, \$110,738 ; in services, &c., suppose saving,..... | 10,000 |
| Money expended in laying dust, &c..... | 6,000 |
| Saving in maintaining pumps, &c.,..... | 18,238 |

Saving to the City by introducing water, in services, taxes, and money, annually, \$242,939

152. The above amount may appear to many to be large, but I am satisfied if a careful investigation should be made, it would be much swelled beyond the sum I have named.

153. To the above amount is to be added the actual expense of the shipping, and the City in procuring wholesome and palatable water. In a former part of my communication, I have stated the basis of the calculations, except the Manhattan Works, which I suppose is \$10,000 ; and nothing now remains but to enumerate them.

Expense of the supply brought to the City by water

| | |
|--|-----------|
| carts, | \$273,750 |
| Supposed revenue of Manhattan Works, | 10,000 |
| Expense of supplying vessels, &c. | 49,945 |
| Total cost of procuring water to the City, | \$333,695 |
| Add saving by its introduction, | 242,939 |
| Total amount of all items, | \$576,634 |

154. If we take the whole sum saved to the City by introducing water, it would be equal to an investment of a capital at five per cent, of \$11,532,700, or that amount could be expended for that object. If we, however, limited our inquiry to the cost of the present supply of water, it would be more than a capital at five per cent. of \$6,669,980; and if we entirely excluded the Manhattan, and the supply for shipping, it is equal to a capital at five per cent. of \$5,475,000, and as the works are not supposed to cost over \$2,500,000, the first statement is capable of paying twenty-three per cent. interest on the cost, the second, over thirteen per cent, and the last over eleven per cent. This must therefore completely settle the question of the productiveness of the undertaking.

155. Again, if we take the capital equal to an interest of five per cent. on the saving, and the expense of introducing water, and divide it by the number of lots in the fourteen Wards, it is equal to an investment by each lot, of a capital over \$381, or to provide for a tax to supply themselves with water, and maintain the police of the City. The introduction of water would not amount to more than an investment of \$81 for each lot, and would consequently save \$299. Other calculations could be made, but are deemed unnecessary.

156. My communication may appear unnecessarily long; but as I could not with propriety and justice to others, make it shorter, and also present my own views frankly, and give a fair statement of all questions connected with your wishes, it must render an apology unnecessary for its length.

157. In conclusion, I recommend that the supply for the City

be taken from the Croton River; that minute surveys be made before the plan of the Croton route is determined.

That the expense of the works will not probably exceed \$2,500,000.

That the advantages of the supply of water to the City would not justify any expenditures exceeding \$11,000,000; and the works may be put in operation three years after their commencement.

With my best wishes for the success of this useful undertaking,

I have the honor to be,

Sir, your very obedient servant,

DE WITT CLINTON,

U. S. C. Engineer.

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Street Commissioner's Office, Oct. 29, 1832.

DEAR SIR,

You are hereby requested to take with you Mr. Wm. Serrel and two rodmen, two axemen, if required, and a wagon and horses and driver, and make an excursion, and take levels for the purpose of bringing water to this city.

You will proceed first to Harlem River, at Macomb's Dam, and make the tide water at high tide your starting point.

Proceed then to ascend the high ground, and gain a piece of table ground, of at least three or four acres, which is 120 feet above tide water ; there make some permanent marks which can be found hereafter.

You may find this ground within half a mile, I hope, of the river. It is desirable to find it as near Macomb's Dam as possible.

When you have found this ground, then carry a level northward, rising twelve inches in each mile, and trace out such a level as is the easiest and cheapest to carry a canal or brick tunnel upon. Pursue this between the Bronx River and Hudson River, and between Bronx and Saw-Mill ; and it is believed that this will bring you out to the Bronx at the mill against the village of White Plains ; at this point the Bronx is said to be 133 feet above tide. However, pursue the level as above until you do strike the Bronx. You will note all the ground you pass over, whether level, side hill, rocky, &c. whether easy evcavation ; and all the outlines to enable us to estimate pretty fairly the expense.

All embankments are to be particularly noted, and the amount in yards given, and also the place where earth can be obtained to make this embankment, and of what quality it is, so far as to give a little bearing upon the expense of it.

If you should be driven to pass any stream, which I think you

will, one in particular, Valentine's Brook, take a look to see how this can be brought into our tunnel, if it is worth bringing in ; or whether an artificial reservoir can be made at the head of it. All Reservoirs for this purpose should be made in deep ravines, so as to keep the water the greatest possible depth, and give the greatest quantity with the least possible surface.

When your party are going on, and you see them fairly started, and they can move on two or three days without you, I wish you to examine Byram Pond and Wampus Pond, and see whether they are favorably situated to raise them a few feet and hold on upon their waters, to carry us over a dry time.

And when you are out on this examination, I wish you to go over to Croton River and examine the Branch which comes from Mahopook Pond. I am credibly informed, that this stream gives, in the driest time, thirteen million gallons ; and that it is so situated, that it can be brought over the other branch of the Croton, on a level 150 feet above it, and bring it round, and, by a short tunnel, to bring it over into the head of Bronx or Saw-Mill River ; and we know that Saw-Mill River, at Union Village, can be brought into the Bronx, above White Plains, for four or five thousand dollars.

As a general remark, I pray you to take a general look of the country in every direction, and see whether artificial reservoirs can be formed at the head water of the Bronx, or in any other direction available ; so that we may be able to look hereafter to such a source when we want it.

Wishing you every success in the expedition, and wishing you good weather and as speedy a return as may be,

I am, very respectfully,

Your obedient servant,

TIMOTHY DEWEY, Esq.

BENJAMIN WRIGHT,

Street Commissioner.

Note.—Please leave Bench Marks at least every mile, made on trees, door sills, or rocks, which can be easily referred to hereafter.

New-York, 29th November, 1832.

To Benjamin Wright, Esq.

SIR,

In pursuance of your instructions, dated 29th October last,

It is Respectfully submitted :

That, on proceeding from Macomb's Dam, upon the high land above, and examining for a spot of "Table Land, 120 feet high, containing three or four acres, and capable of being made a Reservoir," no such spot could be found nearer than about a mile and three quarters from the starting point. The distance between that and Macomb's Dam, is over a very rugged line, mostly of stratified gneiss rocks, dipping to the west, and interspersed with hollows, requiring considerable embankments to maintain the line of a tunnel or open canal ; but not any where offering facilities of earth or other materials fit to aid in making such embankments.

From this point, the country, for near two miles, is tolerably open, and such as does not offer any extraordinary difficulties in the formation of a canal or tunnel. Continuing the level, and entering the valley of the Bronx on the west side, the required line could only be obtained upon the faces of immense rocky bluffs, separated by deep ravines, without any supply of earth, or other materials, within any reasonable distance, suitable for the construction of such a work. This character of country continues, with little variation, until about a quarter of a mile above Underhill's Bridge, where the land became so exceedingly abrupt and high, that it became requisite to cross to the eastern bank of the stream, before the work of running the level could be continued. The level struck the Bronx at about 136 feet above tide, near Major Popham's Mill, in Scarsdale, about sixteen miles from Macomb's Dam.

From the character of the country, it may be stated, that a safe "open canal, or closed tunnel, descending one foot in a mile, from

a point on the Bronx, so as to arrive on the high-land near Maccomb's Dam, at an elevation of one hundred and twenty feet above tide," is wholly impracticable.

There are other objections to taking the water out at a high level ; one of the most important is, that by such a course, all the supply coming from the Sprain, and other considerable streams and springs, which are sources of supply below, will be entirely lost to the main object.

The levels, as shown by the accompanying field notes, are herewith submitted.

The next point of inquiry, is, "the sources of supply, and whether these can be artificially rendered more effective."

The Rye Ponds exhibit the strongest evidence, that they have been much higher than they now are. Every information and observation confirms the belief that these masses of water continue the whole year in a very pure state. On the 15th November, on guaging the outlet, it appeared that 4,173,000 gallons ran off every twenty-four hours. The large pond may be raised eight feet, and the outlet reduced six, making fourteen feet of reservoir. Thus a supply may be retained in the large pond, equal to 823,284,000 gallons.

From the north east corner of Rye Pond, the land rises very gradually, until near the Byram River, when it falls again to the Byram ; presenting no obstruction worthy of notice to cutting a small canal, by which the surplus water and freshets may be turned into the Rye Pond, and would probably fill it eight feet in one winter, after the dam is made.

From hence, to Byram Pond, the land rises considerably ; and a large quantity of rain water falls annually within this section. The Byram stream, when guaged on the 16th November, above the junction with the Wampus, gave 8,366,000 gallons passing in twenty-four hours. The Byram Pond, of one hundred and twenty acres, may be raised ten feet above its present level, and drawn down six feet below. The rise would only flood about twenty-five acres of wet meadow land ; and 501,626,000 gallons would be reserved, beside the current supply, when the Pond is once filled.

From the quantity of water running off the surrounding high-lands, this may be effected in twelve months. It would be requisite to change a line of low road, on the north end of the Pond, so as to bring it above the increased height of water ; the cost of doing this, was estimated on the spot at \$400.

The Wampus Pond lies high, and has not any considerable surrounding surface of land, whence the fall of rain would raise it if embanked higher than it now is ; and by information derived from the owners of the contiguous mills, it appears to vary very little all the year. When gauged on the 16th November, the outlet gave 1,735,000 gallons in twenty-four hours, and this quantity is fully trebled from additional streams and springs by the time it unites with the Byram River. The two, jointly, will give 13,573,000 gallons daily. Wampus Pond can be lowered eight feet, and thus furnish 114,956,160 gallons of reservoir, as indicated in the accompanying table.

There is another course through which the waters of the Byram and Wampus may be connected with the Bronx. The surplus water may be taken south westerly, through a village called Mile-square, about a mile and a half from Wampus Pond. Here a short deep cut or tunnel, will bring it into the west branch of the Bronx, by a course lying entirely within the State of New York.

Thus far, our labors and observations were continued jointly ; Mr. Serrell returned to New York, to proceed with the report, that it might be ready, as desired by the Committee, at the earliest convenient day.

My instructions required that I should proceed to the Croton River, to examine if it was practicable to connect its waters with those of the Saw-Mill and Bronx ; or if any of its tributary streams could be given the same direction.

I was particularly directed to examine the Muscote River, which flows from the Mahopack or "*Tomahawk*" Pond, situated in the town of Carmel, and learn if this stream could be conducted near to the Croton, at so high a level as that it might be brought over its valley by an aqueduct, and directed to the head waters of the Saw-Mill River, and thus aid the general supply.

I found the Cross River, a branch of the Croton, flowing, at a level, near the village of "Cross River," sufficiently high to be connected with the Kisco River, near Kirby's Mill Pond, in New Castle; and it may be united, by a long deep cut, with the Saw-Mill River. The cost of a canal or tunnel about ten miles in length, would be so great, that I consider it financially impracticable.

I could not discover, nor do I believe, from an examination of many miles of the valley of the Croton, that it is possible to bring any of its water to mingle with those of the Saw-Mill or Bronx, without the aid of expensive machines, from the great height the water must be elevated.

I found the Muscoot a very small stream, and running nearly as low as the Croton, three miles from its mouth; the grounds on its banks broken and mountainous to such an extent, as to render it impossible to gain any thing from it.

I then proceeded up the valley of the Kisco, which discharges its waters into the Croton, near Pine's Bridge. This river has its main source in a large pond, in an extensive valley; at the outlet of which are Kirby's Mills.

By rising the dam at the outlet seven feet, I am assured by the proprietor, that one thousand acres can be ponded, and the water will flow near to the north-westerly side of Wampus pond. I assume that five hundred acres may be overflowed, and all low, wet land, of little value. The proprietor of the mills assures me that he will not object to its use if his property is not injured, or he is fairly compensated for such of it as is used for this purpose.

By rising the dam seven feet, and reducing the outlet four feet, we shall have an accession of 1,436,952,000 gallons, which added to the stores of the Rye, Wampus, and Byram, will give an aggregate available supply of 2,876,819,040 gallons, which can be held in reserve when once filled, (which I think they can be in two years,) in addition to the ordinary flow of the rivers and ponds. This quantity will be equal to 7,881,696 gallons, each day in the year.

The water of the Kisco Pond can be connected with the east

branch of the Saw Mill River, by a canal or tunnel of about two and a half miles in length. The ground is favorable, but one deep cut will be necessary, about six hundred feet long and twenty feet deep. The waters thus connected, can be easily and cheaply conducted to a branch of the Bronx, from the Saw Mill River, by a short canal, commencing near Unionville church. By this course, the mills on the Saw-Mill River will not be injured, and additional reservoirs can be formed in its valley, if ever needed.

It must be evident to those acquainted with the annual fall of water in this climate, that there is a wanton waste, or loss of this element in this section of country, from some cause; and that it will not be necessary to resort to other sources of supply, for many centuries, if a small portion of what falls, is properly husbanded.

Doctor Baxter has kindly furnished me with the quantity of water which has fallen in this City for the last five years, as indicated by a rain-gauge kept by him. The annual average fall is forty-five inches.

By a careful inspection of the maps, and extensive travel over the country from which the water flows into the Bronx, and can be conducted to it, from the river and ponds I have enumerated, I am satisfied that a flow from 75,000 acres can be depended on.

The annual fall of water would then be, 75,071,489,361 gallons; equal to a supply of 205,675,313 gallons daily.

The quantity lost by evaporation, in so hilly and rocky a country as this, is comparatively small, to what it is in more even and sandy soils. It is difficult to ascertain, or estimate, what the amount of evaporation may be. It must be inconsiderable, compared with the immense supply, as clearly shown by the great floods which often sweep the narrow vallies, and destroy much valuable property.

To the question, "What becomes of this immense quantity of water?" I can answer in part. From the nature of the soil, and rapid fall of the rivers and streams, it runs quickly to the sea, and is lost in the ocean. The art of man has not arrested it in its course, and stored it for his future use.

Should farther examinations prove it advisable to take the ac-

cumulated waters out of the Bronx, at some point below Underhill's Mills, other extensive reservoirs may be constructed in its valley. The opinion is ventured, that by the arrangements indicated in this Report, many millions of gallons may be preserved for the daily use of the mills on the Bronx, when most needed, by which they will be most materially benefitted, not injured; at the same time the city can command an ample supply for all present and future uses. The examinations have been as extensive and minute as the short time allowed would permit. The result is a conviction, that a canal or tunnel on a high level is not the best or safest mode of obtaining water; and that it ought not to be attempted. That the Croton River cannot be brought in by this route, and cannot ever be needed; that the quantity which can be obtained, at a moderate cost, through the valley of the Bronx, will be sufficient for all the city purposes; that the water is of the purest and best kind for all domestic and manufacturing uses; that much more extensive and careful investigation is requisite, before a combined plan of operations can be formed, by which all the details can be fully understood, and these important objects accomplished. The experience of Philadelphia may afford a useful lesson, to those who would come to hasty conclusions about a work, that requires much consideration, and great skill to perfect.

I am gratified to find by examination, that the facts stated, and positions assumed, by those eminent engineers, Judge Wright and Mr. Canvass White, both as to the quantity of water, and means of connecting the different streams, are fully sustained, so far as I have examined the same ground. The best feelings prevail among the inhabitants with whom we have associated, and we cannot do less than publicly thank them, for the ready and frank manner in which they have answered all our inquiries, and aided us to acquire correct, as well as useful information.

We are, with great respect,

Your obedient servants,

TIMOTHY DEWEY

WM. SERRELL.

Note.—On the 24th inst., there was flowing over the dam, at the West Chester Cotton Factory, eight and a half inches by sixty feet. The manager who has had the charge of the work, assures me, that they have never wanted water, in the past ten years, sufficient to drive all the machinery. Measurements, taken previous to the late rains, showed a flow of about 40,000,000 of gallons every twenty-four hours.

T. D.

TABLE, showing at one view, the quantities of Water which may be obtained from the sources designated in the Report.

| <i>Sources of supply.</i> | <i>Acres of water in ponds.</i> | <i>Gallons now supplied daily by ponds and streams.</i> | <i>Gallons may be reserved.</i> | <i>Additional daily supply for 182 days.</i> | <i>Additional daily supply for 90 days.</i> | <i>Additional daily supply for 56.5 days.</i> |
|---|---------------------------------|---|---------------------------------|--|---|---|
| Rye Pond, raised 8 feet and reduced 6 feet | 225 | 4,173,000 | 823,284,000 | 4,523,533 | 9,147,600 | 2,255,572 |
| Byram River | | 8,366,000 | | | | |
| Byram Pond, raised ten feet, lowered six feet | 120 | | 501,626,880 | 2,756,191 | 5,573,632 | 1,374,322 |
| Wampus River | | 5,205,000 | | | | |
| Wampus Pond, drawn down eight feet | 55 | 1,735,000 | 114,956,160 | 631,627 | 1,277,290 | 314,948 |
| | 16th Nov. 1832. | | | | | |
| Kisco Pond as contemplated | 500 | Estimated when examined 10,000,000 | 1,436,952,000 | 7,895,340 | 15,966,133 | 3,936,854 |
| | 20th Nov. " | | | | | |
| | | 29,479,000 | 2,876,819,040 | 15,866,697 | 31,964,655 | 7,881,693 |
| Aggregate annual fall of Rain, forty-five inches. | 75,000 acres | | 75,071,489,361 | | | 205,675,313 |

TO ALDERMAN JAMES PALMER, CHAIRMAN OF THE COMMITTEE
ON FIRE AND WATER.

Chemical Examination of the Water of Rye Pond.

SPECIFIC GRAVITY, 1,004.

1. BY TESTS.—A solution of soap in alcohol, disturbed the transparency of the water; indicating the presence of saline matter.

2. Nitrate of silver gave a milkiness, indicating muriatic acid.

3. Acetate of lead had a slight effect, owing, probably, to a little carbonic acid, held in solution by the water.

4. None of the barylic salts had any effect. The water therefore contains no Sulphates, nor indeed, had any other test that was tried.

The water reduced by evaporation.

5. Nitrate of silver gave a precipitate, more copious than that of the fresh water. This precipitate very soon turned purple brown, owing to the action of light on the chloride, also indicative of the presence of extractive matter.

6. Oxalate of ammonia gave a trifling precipitate, showing the presence of lime.

7. Carbonate of ammonia had no visible effect, but when a little phosphoric acid was added, a precipitate subsided, announcing the existence of magnesia.

Evaporation to dryness, &c.

8. One quart of the water was slowly evaporated in a silver basin, until the reduced contents could be contained in a small platina dish, weight 241 grains; transferred to this vessel the evaporation was continued to dryness. The dish, with the residuum weighed, warm, 241.6 grains, having increased, in weight only, six-tenths of a grain. The water, towards the last, had a wine yellow color.

9. The dish with the residuum, which was brown, was exposed to a red heat. The extractive matter was converted into charcoal, and burnt off, leaving only three-tenths of a grain for saline matter; but as a little muriatic acid probably left the magnesia, the vegetable extractive might amount to two-tenths only.

These experiments warrant the conclusion, that a gallon of the Rye Pond water contains

Muriate of lime and magnesia, 1.6 grains,

Vegetable extract,.....0.8

2-4

G. CHILTON.

New-York, 11th December, 1832.

TO ALDERMAN JAMES PALMER.

Dear Sir,

I have received your request to try the purity of the water obtained from Rye Pond, the source of the river Bronx, and from which it has been contemplated to supply this City with that article. The experiments which I have already made, will perhaps answer the desired purpose. °

Some years since, I went to West Farms, and procured some of the water of the Bronx, near where it was intended to divert the stream as contemplated by the Water Works Company, and submitted it to the following experiments :

1. A quart of the water evaporated over a spirit lamp, left a small residuum, being in weight about half a grain. Most of the pump water of the City contains several times that amount of earthy matter, as ascertained by myself and others.

2. Soap dissolved in the Bronx water without curdling, and it made a fine soft lather, showing it to be a good and pure water, without a perceptible quantity of foreign matter.

3. Caustic soda was added to a portion of the water, to precipitate such earthy or other substance it might contain. It remained one whole day without alteration, but finally a very slight precipitate

was observed, showing a small quantity of diffusible or soluble substance in it.

4. Nitrate of silver is a test for common or sea-salt ; but on being added to the water, produced no change. This experiment shows the absence of that article in the Bronx water, but it is very common in our pump water.

5. The Muriate of Barytes on being added, produced no change, showing the absence of sulphate of lime, which abounds in our City water.

6. The Nitrate of Barytes gave the same result, and afforded the same conclusion.

7. These experiments were also tried on a portion of the water after it was partly evaporated, and yet the test produced no change, giving further assurance of its freedom from sulphuric salts.

8. The Oxalate of Ammonia, when added, produced no immediate change ; but after a while, a very slight cloudiness, indicative of a minute quantity of lime.

9. Tincture of Galls gave no indication of iron.

These and some other experiments made at the same time, proved that the water of the river Bronx, was remarkably pure and soft, containing a very small portion of lime, and a still smaller one of vegetable matter, making together not more than two grains in a gallon. Some of our City water contains several grains of earthy matter in a quart, making it, in comparison with that of the Bronx, a very impure article. I am inclined to believe, however, from experiments made last year, that the water from the public Well at the Reservoir, in Thirteenth-street, is equally as pure as that of the Bronx.

I am respectfully, your most obedient,

SAMUEL AKERLY.

Grand-Street, 11th mo. 27th, 1832.

TO ALDERMAN JAMES PALMER, CHAIRMAN OF THE COMMITTEE ON
FIRE AND WATER.

Respected Friend,

I regret that the circumstance of being on the eve of a removal of my residence from this city, and the cares incident to the needful preparation, do not leave me sufficient time to examine the Rye Pond Water (a bottle of which I received from the Committee) with that scrupulous care, which the *complete* analysis of a water always requires.

I have bestowed upon it, however, sufficient attention to prove that it is a remarkably fine water. Its specific gravity, ascertained by several methods, is 1.00065 that of pure water being 1.00000. I took, at the same time, the specific gravity of water from a pump at the corner of Reed and Elm-street, and found it 1.00228. This, as well as the application of almost every chemical test, shows a most decided and striking difference in the qualities of the Rye Pond and our City water.

The tests which I applied to the Rye Pond water were,

1st. Nitrate of Silver.

2d. Oxalate of Ammonia.

3d. Muriate of Barytes.

4th. Barytic Water, }
5th. Acetate of Lead, } both fresh prepared.

6th. Alcoate of Soap.

7th. Tincture of Galls.

Others might have been used, but these are sufficient to indicate the nature of a water which is not decidedly of a mineral character.

On the water of Rye Pond, as contained in the bottle sent me, none of these tests have any sensible effect, except the second, fifth, and sixth.

The second, when added to the water, produced no immediate change, but after standing a few minutes, a slight cloudiness is apparent. This indicates the presence of lime, but it must exist in the water in extremely small quantity.

The fifth test produced, instantly, a bluish cloud, denoting (when considered in connexion with the other tests) the presence of vegetable extractive matter, (the presence of a sulphuric salt would have produced a similar appearance, but the precipitate was soluble in nitric acid, a result incompatible with the existence of a sulphate) but, nevertheless, in very small proportions.

The sixth test is used to show the relative hardness or softness of water, and its effect in the present instance, proves that the Rye Pond is, comparatively, a very soft water.

The first test is to ascertain whether common salt, or any of the muriates (now called hydrochlorates) is present in the water. These are the most common ingredients in all our natural spring waters. The delicacy of the test is such, that, although it has no sensible effect on the Rye Pond waters, a few drops of our pump water, being added to a wine glass of the Rye Pond, a cloud is immediately produced.

I next evaporated a portion of the water, at a temperature below boiling, to less than one half its quantity, and when cool, I again applied the tests. It is obvious, that whatever foreign matters the water contains in its natural state (excepting those of a gaseous nature) it would now contain in more than double the proportion. On this concentrated water, the third and fourth tests had no effect, demonstrating the entire absence of all the sulphuric salts; such as sulphate of lime (gypsum) which so abounds in our pump water, as to occasion an immediate precipitate, when a few drops of that water is added to a wine glass of the Rye Pond water.

On the concentrated water, the first test produces an effect but just perceptible.

The seventh, no effect; showing the absence of iron. It is not likely, I think, that the water contains any metallic impregnation, in qualities appreciable by the common methods.

The fifth and sixth tests produced increased turbidness in concentrated water.

To ascertain the actual quantity of soluble matter, not gaseous, I evaporated about a quart of the water over a lamp, in a clean porcelain capsule, to dryness. This dry powder was collected and weighed. The weight did not exceed half a grain. I ought to observe, that when half evaporated, I filtered it, to get rid of a little dust that had accidentally settled upon it. There was no appearance of flocculi in either of my evaporations.

The powder remaining, was of a brown grey colour. It had a sharp, saline taste, somewhat bitter, and as it effervesces both with dilute sulphuric and muriatic acid, a considerable portion of it at least, must be a carbonate.

Upon the whole, the inferences I should draw from this examination are,—First, that the Rye Pond water does not contain more than two grains of foreign matter to a gallon; a quantity altogether too small to be perceived by the test to operate injuriously upon health, or unfavourably upon any kind of manufacture. *Second*, that the soluble matter of this water, consists of vegetable extract, carbonate and muriate of lime, and, possibly, a small portion of magnesia combined with carbonic or muriatic acid.

May I be allowed to close this account, with the expression of an ardent wish that the Corporation may apply itself in good earnest to the means of supplying this large and growing metropolis, with copious streams of an article so essential to the health and domestic comfort of its inhabitants, and which Rye Pond and the adjacent streams will furnish in requisite purity.

I am, with great respect, &c.

JOHN GRISCOMB,

To the Corporation of the City of New-York.

The following Memoir of the utility and means of furnishing the City with Water from the river Bronx, is respectfully addressed by their very humble servant,

JOSEPH BROWNE:

West Chester, July 2d, 1798.

MEMOIR, &c.

IN a little treatise I have lately published, addressed to the citizens of New-York on the yellow fever, I have endeavoured to show that the disease is of a local nature, arising principally from a source which is pretty much in our power to prevent or remove by an unremitted attention to cleanliness, to which purpose it is obvious that a plentiful supply of water is essentially necessary. It may not be amiss here to recapitulate concisely the principles on which I have founded my theory.

All animals and vegetables are in a perpetual state of decomposition and renovation; the organic principles of those two kingdoms are nearly the same, but differently modified, and which mutually depend on each other for their vitality; this reciprocity is effected through the medium of the atmosphere, which instead of being a simple element, is now well ascertained to be a compound of two gases or airs, unequally combined as to quantity; the smaller quantity which is only about twenty-eight per cent. of the whole, contributes principally to the support of animal life, by the intervention of lungs or something corresponding thereto, and may therefore be called animal vital air. The residue of seventy-two per cent. contributes to the support of vegetables, through the agency of their leaves, and may therefore with propriety be called vegetable vital

air. It is to be remarked, that both of those kingdoms, when in a state of putrefaction or decomposition, furnish the latter species of air only in which animals cannot exist, but in which vegetables thrive well. The putrefactive state of vegetables takes place only after the death of the plant ; but animals have a constant tendency to this state during life, which is more or less strong, according to the temperature of the atmosphere, and which tendency is counteracted by the gas that is received by breaking into the lungs, and separated by them from the atmospheric air, which is known to be the basis of acidity, and has for this reason been called by the French Academicians, Oxygen. Whenever, therefore, greater excess than seventy-two per cent. of vegetable vital air prevails in the atmosphere, the animal vital air must decrease in the same proportion ; consequently the proneness that animals have to a putrefactive state not being sufficiently overcome by this acid principle, diseases of a more or less putrid nature must be the result, in proportion as the deficiency is more or less great, or the tendency more or less strong.

If this theory be just, it is of the utmost importance to remove from the houses, streets, and docks, every species of animal and vegetable matter when in a putrefactive state, to which nothing so effectually contributes as a plentiful supply of water.

Water is not only of infinite importance to the health of the City, considered in a mechanical point of view, but from its known constituent parts, it may also be made to contribute to the same end chymically, being a compound of eighty-five parts of animal vital air, and fifteen of hydrogen or inflammable air. Water, therefore, appears to be Nature's great magazine, in which is locked up an incalculable quantity of this most indispensable requisite to animal existence, which is let loose in its ærial state, by abstracting from it the hydrogen, with which it is combined. This process is constantly performing by vegetables, when in a state of verdure, whose leaves when moistened with dew, or sprinkled with water, having a greater affinity or attraction for the hydrogen, than hydrogen has for animal vital air, a decomposition of the water takes place, the hydrogen becomes fixed in the plant, and the animal vital

air being thus disengaged, is poured into the atmosphere to be from thence again absorbed by animals, without which, their existence ceases.

This fact suggests the propriety and utility of encouraging the planting of trees in all such streets as are not too confined, which trees should be frequently in warm weather sprinkled with water.

On philosophical principles also, the air of a city may be rendered more salubrious by frequently sprinkling the streets with water in dry, hot weather, by which means a rapid evaporation takes place. In the East and West Indies, the cooling of liquors by surrounding the bottles with wet cloths, and exposing them to a current of air, is a practice well known; the following theory accounts for the fact.

The heat or caloric with which all bodies are combined, has a constant tendency to equalise itself with all surrounding bodies, a process which is longer or shorter in its operation, in proportion as those adjoining bodies have a less or greater affinity for caloric. The same body with different quantities of caloric, may be either solid, liquid, or æriform; for instance, water with less caloric becomes ice, with more it becomes vapour. Water is one of those substances that has a peculiar aptitude to combine itself with a surplus of caloric, which then assumes the state of vapour, and flies off, leaving the body with which it was previously combined, cooler in proportion as this new combination has taken place. The sun itself is probably not hot, it may have only the faculty of excitement, that is, of evolving caloric from a latent to a perceptible state, and this excitement is generally in proportion to the density and colour of the body on which it acts; its effects are therefore scarcely, if at all, perceptible in its passage through the atmosphere, which can only be heated by coming in contact with some more solid body that has felt its influence.

Since New-York has been paved, the bricks in the streets, in hot summer days, are frequently heated to 150 degrees of Fahrenheit's Thermometer; the surrounding atmospheric air must, therefore, slowly partake of this heat, and consequently, become more rare, which is, I conceive, one of the causes of its insalubrity, for the

same volume of atmospheric air will not contain half as much animal vital air when the Thermometer is at 90, as it does when at 32. That is, a cubical foot of atmospheric air does not weigh half as much in summer as in winter, which is probably the reason why frosty weather is so sure an antidote to the yellow fever. Whatever then, will in any degree tend to cool the air of the City, will, in the same proportion, render it more healthful.

I do not presume to say that the introduction of a large quantity of water into the City, would alone prevent the rise and spreading of putrid diseases, but I am well warranted in saying that, under providence, it would more than all other things, contribute to this most desirable end.

Next to pestilence, fire may be reckoned the greatest calamity to which Cities are subject. I need not take up any of your time in mentioning the immense advantage of always having at hand a plentiful supply of water, on such a melancholy occasion. Those two motives are alone, one would suppose, sufficient inducements to procure, almost at any price, a permanent and plentiful supply of water, as the principal means of preventing or at least, diminishing such catastrophes; but exclusive of those advantages, there is another, though of a secondary nature, yet as a source of comfort and pleasure, is well deserving attention.

There is nothing in warm climates that blends the useful and agreeable so much as public fountains and private baths. In ancient Rome, they were deemed not only luxuries, but became almost necessities, for every garden had its fountain, and almost every house its bath. The art of conducting waters from different sources to their Cities, (but principally Rome,) and the distribution made of them among the Citizens, was esteemed by the Princes and chief Magistrates of sufficient importance to deserve every attention. Rome was furnished with water from ten principal aqueducts, at the rate of nearly three hundred millions of gallons daily: it was conveyed to large covered reservoirs, from whence it was distributed by subterraneous tubes, to fountains in different parts of the City, and from thence it was conveyed to their houses and gardens. These fountains were one of the principal ornaments of the City, being accompanied with statues of marble and bronze.

All these works were maintained with the greatest order and discipline, which requiring great authority, the Consuls, and even the Emperors themselves, made it a part of their immediate duty, regarding the supplying of the City with water as a thing of the first importance. The Consuls had, for a long time, the superintendence of the aqueducts, but afterwards, this part of their duty was consigned to the Ediles until the time of Augustus, who, to recompense Marcus Agrippa for the extraordinary pains he had been at during his Edileship, who had caused to be made seven hundred reservoirs, one hundred and thirty chateaux d'eau, and one hundred and fifty pumps, magnificently decorated, created him superintendent of the water works, and President of a company of 240 officers or commissioners. There was afterwards another company established, consisting of 460 persons, both of which companies were divided into different departments, whose exclusive employment was the conducting and distributing water through the City. The expense of those water works, as may well be imagined, was immense, it amounted to upwards of one million two hundred thousand dollars annually, including the salaries of the officers, and the repairs of the aqueducts, basins, fountains, &c. Each Citizen paid in proportion to the quantity of water he was supplied with, and even this sum was some years inadequate to the purpose; an extraordinary tax, therefore, sometimes became necessary.

The principal Cities of modern Europe, to be furnished with water, are obliged to have it brought to them at considerable expense, particularly London and Paris; the former of those Cities, exclusive of the immense quantity that is daily forced from the Thames, by means of large water-wheels that are turned by its current, and also by steam engines, is largely indebted to the patriotic and great exertions of a single individual, a Mr. Hugh Middleton, Citizen and Gold Smith of the City of London, who in the year 1614, having obtained an Act of Parliament for the purpose, brought in an open canal to London, the water from the Am-Well and Shad-Well, in Hertfordshire, a distance of more than twenty miles. It is conveyed to a large reservoir near Islington, from whence it is distributed in Elm pipes to most parts of the City.

This water is now called the New River, and is said to run under near 800 bridges.

Paris is also supplied with water from the Seine, in a similar manner as London is from the Thames; but those parts of the City that are distant from the Seine are supplied with water from springs in the neighbouring eminences of Belleville, pres St Gervais, and Rungis, which is conducted to the City in subterraneous tubes, to different reservoirs and fountains, accompanied with all the works necessary to its goodness and proper distribution. But the most celebrated Water Works now in the world, are those that furnish the National Palaces and Gardens of Marly and Versailles with water. They were constructed for Louis XIV. by a Mr. Rannequin of Leige, and are a monument of the magnificence and extravagance of that king. The water is taken from the river Seine and forced 500 French feet above the level of that river, to a large reservoir, by means of three sets of pumps; the first set carries it up 150 feet, the other two carrying it up 175 feet each; the whole number of pumps employed are 253. The quantity of water formerly raised in a day, was 1,500,000 gallons, but at present, owing either to decay or neglect in the management of the machine, it does not now raise half this quantity. This famous aqueduct is said to have cost five hundred thousand pounds sterling.

Were the preceding purposes the only ones for which the City of New-York wanted a supply of water, it might easily be procured in any quantity, by means of steam engines, from the rivers that wash the shores of the city. But there is another, and of more importance in the opinion of the majority of the citizens of New-York, than all those that have been already mentioned, and for which purpose, the river water adjoining the City cannot be used, (to wit,) for the constant daily consumption of families, for drinking, washing, cooking, &c.; for those occasions we must look to some other source.

The large stagnating, filthy pond, commonly called the Collect, which now is, or soon will be, the centre of the City, has been

looked to by some people, as a fund from whence an adequate supply might be obtained, by means of a steam engine,* for all the purposes already spoken of. I cannot undertake to say, that this source would, at present, be incompetent to all the preceding purposes, for which a supply of water is wanted ; but if the quantity naturally discharged from this pond, be the whole that is furnished by its springs, then I might say with propriety, it is infinitely too small for those uses. But admitting, that at present it might be competent, the time will come, and that very shortly, from the growth of the city, when this source will most certainly be very inadequate to the demand. And again, supposing the pond to contain and furnish enough, it is a consideration well deserving attention, whether a pond, into which the filth from many of the streets must, without very great expense and care, be constantly discharged, and to which the contents of vaults, &c. will continually drain, is a desirable source from whence we should like to take water for drinking, cooking, &c. without taking into the account its noxious qualities, medically considered ; although it may be laid down as a general rule, that the health of a city depends more on its water, than all the rest of the eatables and drinkables together.

With respect to other sources from small springs, ponds, &c. on the Island of New-York, some of the same objections may be made to them all ; the City must then look to some other place for a permanent and plentiful supply of good water.

The stream in the county of West Chester, known by the name of Saw-Mill River, which empties into the North River, beyond the nineteen mile stone has been mentioned by some as excellent water, and capable of affording all that is wanted. I have no ob-

* The expense of a steam engine, of a cylinder sufficiently large to force up 300,000 gallons of water per day, a height of forty feet, with the house, apparatus, and pipes of conduit to a principal reservoir, including the cost of such reservoir, would amount to \$50,000 ; such a steam engine would consume, daily, a chaldron of coals, or two cords of wood, which may be deemed equal to another capital of \$50,000 ; so that the first cost of the machine, &c. and its continual charges, may be deemed equal to a capital of \$100,000, exclusive of risk, repairs, &c.

jections to make to the truth of this assertion, but the expense of bringing this water nineteen miles over so rough a country, would be greater than could be probably raised for this purpose, even admitting the necessary supply could not be had otherwise ; but fortunately New-York is not in this dilemma, for there is another source equally copious, and full as pure, that may with great facility be obtained for a quarter part of the expense, to wit :

The River Bronx,

Whose principal source is from a small lake, about four miles to the northward of the White Plains. This lake is nearly three miles in length, and half a mile wide. After meandering twenty miles through a rocky part of the county of West Chester, it falls into the East River, just above Hunt's Point. The nearest point of its approach to the city of New-York is at present about twelve miles from the City Hall.

This water is remarkably pure and pellucid, and from a chymical analysis which has been made of it, it may be relied on as possessing no noxious qualities. The inhabitants who live near its banks, are in the constant habit of using it in preference to other water during cold weather, and experience no bad effects from it. It may not be amiss to mention a few tests that are the only ones necessary to ascertain what is good water,—the first is to boil leguminous vegetables in it ; the second to mix it with soap ; for water that contains any of the faults with an earthly base, such as nitrate of lime, and magnesia, muriate of lime and magnesia, sulphate of lime, or carbonate of lime and magnesia will not do well for either of the above purposes, for having great affinity to the musilage of plants, it extracts it and thereby renders them hard and disagreeable to the taste. Soap is likewise an excellent test, which is known to be a chymical compound of alkali and oil, or fat. All salts with an earthly base, decompose soap by a double exchange ; their earth unites itself with the oil or fat, whilst their acid combines with the alkali of the soap, and by the combination of the oil and earth is formed a soap, which is insoluble in water, and makes those clots or curdles which we perceive in mixing soap with what is

generally called hard or crude water. Water then that is clear and from a running source, that boils leguminous vegetables tender, in which soap readily dissolves, and has no bad flavour, may be pronounced good water; to all these tests, the water of the Bronx has been submitted, and from whence we cannot but pronounce it excellent. I shall now endeavour to point out an easy method of carrying it to New-York; it has already been mentioned, that its nearest approach to the City-Hall, is about twelve miles distance; but at about fourteen miles distance, which is half a mile below Williams' Bridge, is a piece of low meadow ground, in which arise two springs, one of which runs easterly, and empties itself into the Bronx, at not more than four hundred yards from its origin; the other spring runs southerly, and empties into Harlem River, after traversing a distance of about six miles. The place where those springs originate, is not more than five feet above the level of the Bronx, and sometimes part of the river when raised by a considerable freshet, has run over part of this meadow, and emptied itself into Harlem River. From those reasons, then, it is obvious that by building a dam five feet in height across the Bronx, below where the first mentioned spring empties itself into it, and by digging a canal four hundred yards in length through the meadow, the whole of the Bronx if necessary, might be diverted from its old route, and thrown into Harlem River, at about eight miles distant from the City Hall. The place where the Bronx may be thus diverted, is about fifty feet above high water mark.

When I first interested myself on this subject, I was in hopes a place sufficiently high might have been found, from whence the water of the Bronx could have been conducted to New-York, in pipes of conduit, without any previous machinery; but I am now satisfied, no such place exists; for although water in an open aqueduct, will run with tolerable fluency, having only six inches fall in a mile, yet in a pipe of conduit, it requires a five feet fall to produce the same effect, and even this fall is insufficient, where the pipe of conduit is of considerable length and of small diameter; for the friction that is occasioned by the sides of the pipe of conduit is in a quadruple ratio with its length. Now as the ground

in the City of New-York, to which water ought to be conveyed to a principal reservoir, is about forty feet above high water, which is ten feet only below the level of the river from where the Bronx may be diverted, I consider it, as a fall, perfectly inadequate to any design of conveying the water in a pipe of conduit only. It becomes necessary then, that the water of the Bronx must first be elevated, by means of some machinery, which I shall now endeavour to point out.

A simple mode of brining the Bronx to within eight miles of the City Hall as we have seen, is within our reach ; let us suppose it now at Morrisania, and emptying itself into Harlem River, out of the little creek that divides the land of Colonel Lewis Morris from that of Mr. Gouverneur Morris ; it will then be about forty feet below the height of the Park in front of the goal, &c. It will therefore become necessary to elevate it, at least, as high as this spot ; probably, it might be still better to give it a greater elevation, for instance, as high as the Corporation land in the vicinity of the Dove, about five miles from town, which is about forty feet above the Park, or eighty feet from high water mark.

The first thing to be determined, is the quantity of water that would be deemed sufficient for all the purposes already mentioned. The supply ought to be a liberal one ; it appears to me, it ought to be, at least, 300,000 gallons per twenty-four hours ; one third of which will be competent for all potable and culinary purposes, washing, &c. ; there will then remain 200,000 gallons to be daily made use of for washing streets, &c. The principal reservoir should contain at least the whole of this quantity, as a resource in case of fire, which, with its permanent supply, is more than ten of the largest fire engines could exhaust in six hours. Admitting then, that 300,000 gallons are sufficient for the daily allowance, the next thing to be considered, is the power to be applied to force this quantity of water, a perpendicular height of eighty feet ; for it is to be observed, that its perpendicular height is only to be regarded in the calculation, and not its horizontal distance, except that distance be a great one ; for this reason it is probably better to force water a perpendicular height of eighty feet, at the horizon-

tal distance of three miles, than to force it forty feet high at the distance of eight miles. I do not say that in all cases, this is correctly true. If water running in pipes of conduit, had no other obstacle to surmount, than those occasioned by the friction of the sides of the tubes, rules sufficiently correct for practice might be deduced, but it is almost always the case, that in pipes of conduit of considerable length, part of the course is zigzag, and part of it over ascending and descending ground, from both of which causes the velocity of water is greatly retarded. It is, therefore, extremely difficult to apply with correctness any theory to practice. It is always most prudent therefore, to make ample allowances in all our calculations.

The power I propose to apply for this purpose, is the Bronx itself. If the whole of the river be diverted in the way I have mentioned, in the driest seasons, it may be calculated that the water issuing from it, is equal to 1,200 cubic feet per minute, which at 62½ lbs the weight of a cubic foot of water, is equal to 135,000 hogsheads of 100 gallons each, per 24 hours. Near where this water would enter Harlem River, is an excellent situation for a mill seat; suppose a dam then to erected of six feet in height, at this place, it would furnish a power to be calculated as follows:

From acknowledged and experimented principles of hydrostatics, the velocity of water is as the square root of its perpendicular height; that is, the velocity of water spouting under a four feet head is sixteen feet per second nearly, (I purposely avoid fractions,) consequently the velocity of spouting water from under a six feet head will be nearly twenty feet per second, and if the aperture of a penstock be twelve inches square, the quantity of water discharged per second will be twenty cubic feet, which is the quantity that the Bronx will continually furnish in the driest seasons; this, then, creates a power of 1,250 pounds per second, which is the weight of twenty cubical feet of water. The velocity of a water wheel, when loaded with its maximum, is one third of the velocity of the water spouting on it. Admitting then we have a water wheel of twenty feet diameter, which will be sixty feet circumference, it will make seven revolutions in a minute under a head of six feet

water with a penstock of three inches high and thirty-six inches long, which must be the length of the float boards of the water-wheel. On the water wheel shaft must be a cog wheel to drive one or more wallowers, to move the pistons of the forcing pumps; the cog wheel should be six feet diameter, having fifty-four cogs in it; the wallower one foot diameter, with nine rounds in it; the wallower then makes six revolutions to every revolution of the water wheel, consequently the pistons of the pumps will make forty-two strokes in a minute. Admitting the pipe of conduit leading from the pumps to the reservoir at the Dove, to be six inches diameter, and fifty feet perpendicular height, when full of water, its weight will be equal to fifteen square feet or 937lbs. : this weight is to be overcome at each stroke of the piston by the weight of water as I have already mentioned, that is perpetually operating on the water wheel, which is equal to 1,250 pounds. The arms of the water wheel act as levers, whose impulse is ascertained by multiplying their length by the weight of water pressing on them; 1,250 pounds then multiplied by ten, the length of the arm from the centre of the shaft is equal to 12,500 pounds, which must be divided by the length of the arm of the cog wheel, which being three feet, leaves 4,166 pounds as the actual power of the water wheel, five-ninths of which is lost in overcoming friction, &c. ; of course four-ninths can be calculated on, only, to produce its greatest product or maximum effect, which leaves 1851 pounds as the efficient power of the water wheel, which is equal to the power requisite to work four forcing pumps, two of which will be in state of inaction whilst the other two are forcing. As the water wheel makes seven revolutions in a minute and the wallower six times as many, each pump makes forty-two strokes in a minute, the four pumps will then make together, 168 in a minute. If the crank of the wallower be nine inches deep it will give eighteen play to the piston, and if the piston works in a six inch bore, it will deliver, at each stroke, 436 cubical inches of water, equal to fifteen pounds, which for the four pumps is equal to 315 gallons per minute, or 463,600 gallons per day. As the pistons and valves of them are never perfectly tight,

it is usual to allow one-fifth wastage for this purpose, which leaves 362,880 gallons to be delivered daily into the reservoir at the Dove.

I have thus shown, that the Bronx itself may be made use of as the only agent requisite to deliver at a reservoir, near the Dove, all the water necessary for the daily consumption of New-York. From the reservoir at the Dove, a pipe of conduit of six inches diameter will be requisite to deliver the water to a principal reservoir in or near the City.

I shall next endeavour to calculate the expense. Below the place mentioned as a proper situation for diverting the Bronx, are four mills, one employed as a snuff mill, the next intended as a mill for spinning of cotton, &c. ; the next a grist mill, the last used for a bleach mill and calico printing. For six months in the year, those mills will not be much injured by diverting part of the stream; for three months they may probably be used one half of their time; but for three months they may be reckoned as totally idle; that is July, August and September.

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|---|----------|
| The damages to those mills, which must be paid for, may be stated at | \$20,000 |
| To building a dam across the Bronx, purchasing the land adjoining and paying damages for overflowing lands above the dam | 2,000 |
| To digging a canal through a meadow four hundred yards in length at the Bronx, and widening the pre- sent rivulet, with damages done to the lands from the Bronx to Harlem River | 5,000 |
| To building a dam across the rivulet at Morrisania; purchasing lands for the works to stand on, and for overflowing land above the dam | 4,000 |
| To water-wheel, six pumps,* mill-house, and Over- seer's house | 6,000 |
| To 44,000 feet of pipes, of six inches diameter, and laying the same three feet under ground, at four shillings per foot | 22,000 |

* I have calculated for two additional pumps, in case of occasional repairs.

| | |
|---|-----------|
| To extra expenses in crossing under Harlem Bridge, and securing pipe from frost | 2,000 |
| To damages to land in laying the pipes..... | 1,000 |
| To two covered reservoirs, each to contain 300,000 gallons of water..... | 10,000 |
| To superintending, and a number of small charges not enumerated, such as air pipes, regards, crossing gullies, &c | 28,000 |
| | <hr/> |
| | \$100,000 |

The streets in the City through which the pipes will be carried, will probably be about twenty miles in length; the expense for piping the same with fire plugs, air pipes, one or two public fountains, &c. may be estimated\$100,000

I have thus estimated the whole expense to be \$200,000. In making my calculations, I believe this sum will be the outside cost; and considering the magnitude of the object, and the wealth of the City of New-York, the sum is very trifling.

The Corporation is considering this subject, will no doubt take in view the rapid growth of the City, which must continue to increase in a certain ratio with that of the State and the neighbouring States, where there is no competitor city, for their commercial concerns. Admitting that \$300,000 gallons of water are at present only sufficient for the present necessities of the City, in a few years this quantity will be too small. The zeal of the Corporation, as fathers of the City, will induce them to regard the future, as well as the present welfare of the City. The river Bronx contains more than forty times the quantity of water that is now wanted; and although the river is capable of forcing up more than is at present required, yet in a short time it will not be able to do so; it may then be not amiss to inquire what other mode may be adopted for this purpose. The river Bronx may at any time, for a small additional expense, be diverted from the place which I have suggested as the best at present to carry it to, to the excellent bridge which has lately been built over Harlem River, by John B. Coles, Esq. Under this bridge Mr. Coles is

authorised by act of the Legislature, to erect a mill-dam across Harlem River, which, as a tide-mill will be one of the best in the world; it will be capable of carrying from sixty to eighty ton of stones; a part of the whole of this power may, if necessary, be employed in forcing the Bronx to New-York, instead of grinding grain. This consideration will, no doubt, have some weight with the Corporation.

I am under no apprehension that the Corporation will ever seriously think of forcing the inhabitants to drink the disgusting water of the Collect; but it is of considerable importance, that the Corporation should speedily determine with respect to the Bronx; at present, the value of the mills that will be affected by diverting the water is not great, but the excellence of the water, the healthiness of the country, the goodness of the roads from New-York, and its vicinity to that city, point it out as a most eligible situation for different manufactories, when expensive establishments of this kind take place. It will be very difficult for the city to command a river, which will, one day or other, be found to be of infinite importance to its interest. If the Corporation should not at present, determine to have its water brought to the city, no time should be lost in purchasing the right of doing it at some future time; it may never hereafter be in their power to do it, at least without a very great expense. As the funds of the Corporation are probably not adequate to an undertaking of this kind, I shall beg leave to submit to their consideration, a plan of an association for the purpose. The sum requisite, as already stated, is \$200,000. As a great majority of the inhabitants have an interest in such an undertaking and must feel a wish to promote it, I shall propose that the stock should be divided into two thousand shares of one hundred dollars each; that three gentlemen should be appointed to receive the subscriptions, but in such a way, that no man should be entitled to more than one share, at least, not till after a given time, and that the whole number of shares should not be subscribed for by single shares. There can be no difficulty in procuring, from the Legislature, an Act of Incorporation for such and

Association, at the request of the Corporation. The outlines of the plan may be as follows :—

The Corporation of the City of New York, engage with A. B. and C. and their associates, to procure an Act of the Legislature, at their next Session, to incorporate as a body politic, the said A. B. and C. and their associates, by the name of the Acqueduct Company of the City of New York, with the authorities and powers incident to such an establishment, on the conditions following :—The said Company engage to supply the City of New-York daily, at the rate of 300,000 gallons of water, from the river Bronx, to be delivered into such reservoir or reservoirs as shall be furnished, at least the ground thereof, by the said Corporation ; that the said water shall be conveyed through the principal streets of the City, in pipes of conduit, in which pipes, at convenient distances, shall be constructed fire-plugs, through which the whole of said 300,000 gallons may at any time, in case of fire, be discharged into any particular street, for which purpose a watchman shall constantly attend at the principal reservoir ; the residue of water not otherwise wanted, shall be daily made use of, under the direction of the Corporation, for washing such streets as they may direct.

That every householder, in all the streets in the said city, through which the said pipes of conduit shall be laid, shall be entitled to receive daily from the same, a supply of at least thirty gallons of water through pipes, to be provided by himself or themselves for that purpose, to communicate with the pipes of conduit.

That the said company shall at their expense, cause to be constructed on the Battery or Bowling Green, as the Corporation shall direct, an ornamental fountain and *Jet d' Eau*, from whence a pipe of conduit shall be carried to some convenient wharf, from whence the shipping in the harbour may be supplied with such quantities of water as their owners may require.

As a compensation for all which, the said company shall be authorized to receive annually from every house in the said City, which is, or shall be built on any street, through which the said

pipes of conduit shall pass, a sum not exceeding an average of two dollars.

That the said Company shall also receive from every house from which a pipe shall communicate with the pipes of conduit, a sum not exceeding an average of eight dollars per annum, both of which sums shall be assessed, levied, and paid under the direction of the Corporation.

That the vessels in the harbour shall not pay a greater sum than per hogshead, for every hogshead they may be sublied with.

Provided always, that the annual net-revenue of the said company, shall not in any year, exceed twenty per cent. of the monies that shall have actually been expended in the construction, repairs, and maintenance of the said works; the surplus, if any, shall be appropriated for such purposes as the Corporation shall direct.

The present revenue of such a company may be estimated as follows :—

To an annual tax of two dollars from 6000 houses \$12,000

To annual payments of eight dollars from 3000 houses . . . 24,000

\$36,000

Deduct for expenses of management, repairs, &c. 10,000

\$26,000

Which is equal to an interest of thirteen per cent. on the original stock.

In the above calculation, I have estimated, that as every house is equally interested in whatever means can be made use of as a preservation from fire and pestilence, each ought to contribute towards it equally in proportion to its relative value; for such purposes an average of two dollars per annum, from each, must surely be reckoned a trifling consideration.

As many parts of the City are contiguous to tolerable good water from pumps, I have estimated one half the houses in the City only, to be supplied from the aqueduct; although as it supersedes

the necessity of having wells and rain water cisterns in the yards, an average of eight dollars per annum, is probably less than the interest of the first cost of wells and cisterns, and their constant repairs, even though the tea water, as it is called, should cost nothing.

If any ideas in the preceding Memoir, shall add to the useful information the Corporation is already possessed of, I shall be happy to have been their subordinate agent in contributing to the health of the City, not by curing its diseases, but what is considerably more meritorious, by presenting them.

Published by order of the Common Council.

ROBERT BENSON, Clerk.

CITY OF }
NEW YORK, } ss.

At a Common Council, held on Saturday the 16th day of March, 1799, the following REPORT of WILLIAM WESTON, Esq., (on the practicability of introducing the WATER of the River Bronx into this City,) made at the request of this Board, was read and ordered to be printed, viz.

SIR,

In compliance with the request contained in your letter of the 18th of December last, I have taken the earliest opportunity, which my engagements and the state of the weather would permit, to ascertain the practicability of introducing the water of the Bronx into the City of New-York. The result of which investigation I have now the honor of transmitting to you, requesting that you will lay the same before the Common Council, who, as the immediate guardians of the City, must feel peculiarly anxious to possess such information on the subject, as may enable them to determine upon the propriety of the measures necessary to be taken to accomplish that important object.

I am sensible that *Estimates* of the expense attendant on the execution, would have been a desirable piece of information; but a wish to render them as accurate as the uncertainty of the business will admit, induces me to request a further indulgence of time, to procure information on several material points, essential to be known, previous to the completion of the necessary calculations, but with which I am at present unacquainted.

Though the amount of the expense, ought, and doubtless will,

have a proper degree of influence on the final decision ; yet, perhaps it is not a disadvantage in the first instance, that the question should be determined on its abstract merits alone.

In an object of this nature, the first point to be fixed, is the quantity of water necessary to be delivered in a given time : was nothing more required than a sufficiency for culinary and other domestic uses, the matter might easily be ascertained. But as the principal object of this undertaking, is the introduction of a copious and constant supply, for cleansing and cooling the streets, it becomes a question of importance to determine, as near as may be, the annual amount of the required demand. Several specific quantities have been mentioned ; but in my opinion, they are all inadequate to the contemplated purpose. In this, as in all other undertakings, I conceive it to be an object of the first consequence, to have the effect dependent on the will, and where, from the nature of the thing, no certain conclusions can be obtained, it is safest to err on the safe side.

Whatever doubts may be entertained of this deduction, as a general principle, I believe there can be none respecting the propriety of it in the present instance ; for however great the amount of the surplus water may be, there are a variety of useful and productive purposes, to which it may be advantageously applied. Proceeding on this ground, I have endeavoured to calculate as near as the want of sufficient data would enable me, the minimum quantity necessary to be introduced in twenty-four hours. Though conclusions deduced from hydraulic principles of the expense of water issuing from pipes of given diameters, placed on the summits of the several streets, would have been much preferable to vague guesses ; yet the infinite variety of cases, arising from different degrees of depression below, and distance from the principal Reservoir, would have rendered the operation a very laborious one ; and from a variety of causes, the result very uncertain. Indeed, every mode with which I am acquainted, may be objected to on the latter principle ; but though it is perhaps impossible to ascertain the exact truth, we must endeavour to approximate as near, thereto, as possible. Conceiving it to be the intentions of the gentlemen, who have

recommended the measure of washing the streets, as essential to the health of the citizens, to have a regular and plentiful current of water running at least twelve hours every day through all the streets, by means of pipes placed at the respective summits, producing an effect similar to what we may observe to be done, by a moderate shower of rain of the same duration. Calculating, therefore, the area of the City, the quantity of water usually descending in the time above mentioned, and making due allowance for such parts of the general surface, as are pervious to water, we shall obtain a result, that perhaps on the whole, will be as near the truth as can be done by any other mode, and sufficient to answer every purpose required. I find that the area of the City, bounded by the East and North Rivers, and the intersection of them by Grand-street, is upwards of seven hundred and fifty acres; and making an allowance of three hundred and fifty for public squares, gardens, and other unpaved surfaces, we have a remainder of four hundred acres; which being impenetrable to the rain, all that falls on that surface, must be discharged by means of the channels of the different streets, into the adjacent rivers. I have made various inquiries but have not as yet received any correct information of the quantity of water produced by a moderate shower of twelve hours continuance. I am, therefore, under the necessity of assuming, as a fact, what may hereafter be proved to be erroneous; though I have reason to believe, that my calculations will not be found to be over-rated. Fixing, therefore, the depth, as shown by the rain-guage, at one fourth of an inch, we shall find the total amount to be 363,100 cubic feet, or 2,221,560 ale gallons; and adding to this, 778,440 gallons, as an adequate supply for domestic consumption, we shall have 3,000,000 of gallons to be introduced into the Reservoir every twenty-four hours.

I beg leave to observe, that an increase or diminution of the above quantity may be effected by one of the plans submitted to your consideration, without materially altering the design or enhancing the estimates, while by the other, the expense will be nearly proportioned to the quantity required. I offer the preceding calculation, merely as an essay to determine a point, which as yet,

has remained undiscussed, though of such importance, that I deem it the basis of the whole work. I shall readily yield to any valid reasons that may be produced in support of variations from the above conclusions.

The quantity requisite being determined, the next point to be ascertained, is from what sources it can be most conveniently derived. I am acquainted with but two modes that deserve any consideration. The first is the introduction of a part of the whole of the waters of the Bronx. The second is a supply obtained from the springs of the Collect. As this question has much agitated the public mind, and each plan in its turn, been extolled or decried by their respective advocates and opponents, it has produced, (what is frequently the effect of a collision of sentiments) a more obstinate attachment to pre-conceived opinions. I do not therefore expect, that any arguments which I shall produce, will reconcile the jarring interests. Yet I trust that the statement I shall offer, (and it is the result of some experience and reflection,) will enable those whose province it is to judge of the merits and disadvantages of the different plans, to select that, which on the whole shall be most conducive to the public welfare.

In order to form a correct opinion on the subject, it is necessary to take into consideration, the efficiency of supply ; the quality of water, as it respects the different uses to which it is to be applied ; and the expense of execution.

On the first of these heads I am aware that it has generally been believed, and pretty confidently maintained, that at those seasons when the demand will be greater and most essential, that the waters of the Bronx are wholly inadequate. These assertions have been made with a degree of positiveness, that would induce one to believe, they were founded on the most careful and accurate experiments, which I have every reason to imagine, have as yet never been made ; instead of which, I have no doubt, they are the random guesses of superficial observation. The question is of such importance, that we ought to be very careful that we proceed upon the most certain grounds. In a matter of this consequence, I may be allowed to be a little diffuse.

It is evident that at the period, when the greatest supply of water is wanted, there will, from natural causes, be the least quantity furnished. This is a common principle, applicable to all rivers and springs; the very few examples to the contrary, are mere exceptions to the general rule. This circumstance has created doubts in the minds of many persons of the efficiency of the Bronx. Previous to my examination of that stream, I had regretted that proper experiments had not been made, at the season above alluded to, as then the fact would have been ascertained beyond all dispute. It is universally allowed, that, for the greatest part of the year, there is a superabundant quantity; what the diminution may be, is not easily ascertained; we must rely altogether upon the information of those persons, whom a long residence has afforded the best opportunities of judging of its usual decrease; but as not materially interested on the subject, we cannot expect any considerable degree of accuracy in their observations. Allowing for this circumstance, I have been careful to take the lowest average of the results of three distinct cases, founded on the best data I could procure, and applying to them well known Hydraulic laws, I am persuaded that the natural stream of the Bronx alone, if conveyed without waste, would be fully adequate to the supply before mentioned, but fortunately a minute accuracy is not required, as will appear by the following account of

The River Bronx,

Whose principal source is from a lake, about four miles to the northward of White Plains, known by the name of Rye Pond. This is a beautiful sheet of water, upwards of a mile in length, containing, as appears from an old survey, upwards of 500 acres of water; which flowing from the outlet, is received into another pond a short distance below; whose area exceeds fifty acres. From this pond it descends with a rapid current, upwards of a mile, to Mr. Roben's mill; a few rods below which, it unites with the other branch of the Bronx. This last, which has its origin in a swamp a few miles to the northward, retains the name of the Bronx, to its source, yet it is the least considerable stream, particularly in the summer, when

it is reduced to a small current: while the other branch is sufficiently large, to turn an overshot wheel, twelve hours out of twenty-four, in the driest times. Rye Pond is bounded by high and bold shores, which tending towards each other at the outlet, are admirably calculated for the formation of an immense reservoir. This being filled during the winter and spring, may be retained until the month of July, when the natural supplies begin to diminish, it may then be discharged periodically, so as to afford any quantity of water that may be requisite for the use of the City.

This lake is supplied wholly by springs, many of which are internal, and few of the others originate more than a mile from the head; these are so constant and copious, that no doubt can arise of their capacity to fill the reservoir to the contemplated height of six feet, which may easily be effected by throwing a dam across the outlet of the lower pond; this would form a sheet of water of more than 600 acres in extent, containing 959,713,920 gallons of water; affording (independent of the natural stream of the Bronx) a diurnal supply of nearly eight millions of gallons, for 120 days; three-eighths of which quantity is sufficient for our purpose; the surplus five millions may be given to the mills below the point of partition; so that instead of injuring (and consequently recompensing them for the damage,) the mills on the Bronx as has been generally apprehended, they will derive essential benefits from the measure. Having, I flatter myself, removed the doubts of the most incredulous, respecting the efficiency of the supply to be derived from the Bronx, it remains to examine the competency of the waters of the Collect. The general bias of opinion seems to lean in favor of this scheme; and if it can be made satisfactorily to appear, that the required supply can be obtained from this source, I am ready to allow that it is a work, that would be soonest accomplished, and attended with the least expense. But we ought to be extremely cautious in hazarding an experiment, where the cost would be so great, and the event so doubtful. The question is of infinite importance, and, unfortunately, one that cannot be determined by abstract reasoning. The capacity of the Collect, has

been attempted to be proved, by its present extent ; but that, in my mind, is a most fallacious mode of reasoning ; for however great that may be, a powerful steam engine would soon exhaust it, unless replenished with numerous and copious springs. On these alone, therefore, it is evident we must depend : and I know of no other mode of estimating their combined effect, than by calculating the quantity of water issuing from the outlet of the Collect ; which even at this time is so inconsiderable as scarce to deserve attention, and if my information is correct, it ceases to flow altogether in the summer. I am sensible that we should not too hastily conclude that the above is the total amount of the supply that may be derived from this source ; I think it very probable, that from the nature of the surrounding ground, (which is a coarse and porous gravel,) a considerable portion thereof, may percolate through, into the adjacent rivers. Much, and perhaps the greatest quantity, is also daily drawn off by the Tea-Water Pump ; which from its vicinity, I have no doubt, is supplied from the same source.

It is true, that by sinking deeper into the earth, an augmentation of quantity would be procured ; yet if we went lower than the surface of the tide-water, I apprehend that the quality would be materially injured. Leaving the question, as I fear it will remain undetermined, we next proceed to examine the quality of the respective waters. To appreciate their merits fairly, we should judge of their utility, by the extent of their application. Proceeding on this ground, I believe it may be safely affirmed, that the water of the Bronx, is at least equal to that of the Collect ; though this is contrary to the general opinion. The only reason that I can perceive for the preference usually given to the last mentioned, arises solely from its superior coolness. However grateful this may be to our feelings, it does not follow that it is equally conducive to health ; for whatever degree of purity it may now possess, the period is not very remote, when from the natural increase of the City, these springs must be subject to those contaminations which have already rendered so many wells unfit for use ; an evil that is daily increasing, and to which no effectual remedy can be applied ; this to me has ever appeared an unsurmountable objection. The idea

of supplying a large city with pure water from a reservoir in its centre, has always been a very strange one to me. From the representations made respecting the water of the Bronx, I believe many persons have hastily concluded that it was unfit for use. When it is considered that the principal cities in Europe are necessarily supplied from rivers, and with water generally taken from those parts, which from a variety of causes are most impure, and yet that the experience of ages has not evinced any known ill effects arising from the practice, I conceive that little fears will be entertained of the salubrity of the water of the Bronx, which is a collection of innumerable springs, issuing from a rocky and gravelly country, and running with a rapid current over a bed of the same materials. It will be conveyed into the City without any additional impurity, and ere it is distributed from the reservoir, will by a mode of purification hereafter described, be rendered as clear as spring water.

The next object to be ascertained, is the practicability and probable expense of accomplishing the respective plans. And here it may not be amiss to observe, that in a matter of such immense consequence to the present and future convenience and welfare of the City, every local view, every subordinate consideration should yield to the general good; that a regard to the primary object alone should decide the question, regardless of a paltry difference of expense, or the immediate emolument to be derived from the undertaking. On the first of the above mentioned heads, there have been a diversity of opinions, which previous to an actual survey, was not to be wondered at. These doubts must now be removed, as it appears from the examination that has been recently made, that the Bronx is sufficiently elevated above the highest parts of the City, to introduce its waters therein, without the aid of machinery; and the intermediate ground, though very irregular, presents no obstacles which art and industry may not surmount. A general view of the subject is all that I am able now to present, and all that is necessary to be known in this stage of the business. An outline of the plan I would recommend for adoption, as best adapted to the varying face of the country, will be sufficient to enable you to form a tolerable correct idea of the eligibility of the measure.

The best situation I have yet seen to draw the water from the Bronx, is a short distance above Mr. Lorillard's snuff-mill; a break in the western bank enables us to divert the stream (by means of a dam thrown across it) without any difficulty. The water being raised six feet above its natural level, will flow over a small swamp, from which originates the little rivulet called Mill Brook. Following the direction of this stream, a canal may be drawn along its northern bank at a small expense, for the distance of three miles, when the ground falling off rapidly, renders it necessary to cross the valley in which Mill Brook runs, by means of an aqueduct, to the opposite rising ground; along which the level may be preserved to the heights above Harlem River. An open walled canal will be the cheapest mode of conveying the water so far; a little loss is not material, as a small increase in the sections will remedy such waste.

A declivity of six inches in a mile, with a section of 1,152 and linear border of 89 6-10 inches, will occasion a velocity in the current sufficient to introduce into the small reservoir at the extremity of the canal, six cubic feet of water per second; which is more than the quantity required, supposing the daily supply to be three millions of gallons. The most difficult and expensive part of the route, will be the conveyance of the water across Harlem River; the most eligible mode of effecting this, appears to me, to be by means of cast iron cylinders, of two feet diameter, with a difference of eight feet between the extremities. This descent will produce a velocity of 22 3-4 inches per second, yielding in that time 5 95-100 cubic feet, while the required quantity is only 5 65-100. From the cylinder to the reservoir, it is a matter of consequence to preserve as much of the water as possible. To effect this object, the bottom and sides should be rendered impervious to that element. An absolute necessity to preserve a regular and uniform descent, leaves us little room in the choice of our route; which will be chiefly along the shore of the North River. The quality and make of the ground, vary much: the greatest impediments are occasioned by the numerous ravines, which intersect the line of the canal—over all these, aqueducts must be constructed. The level may

thus be preserved upwards of six miles, or within two miles of the City ; there it descends so much, that unless higher ground can be found, it will again be necessary to have recourse to iron cylinders, to convey the water into the Grand Reservoir, which may either be placed in the Park, or a vacant piece of ground to the northward of the Hospital, either of which are sufficiently elevated to distribute the water through all parts of the City. —The total distance from the Bronx to the Park, is fourteen miles seven furlongs, and the descent twenty-three feet. It is to be observed, that the principal object of this survey, being to ascertain the practicability of the plan, and neither my time or the season, permitting that minute investigation, which is necessary to be made, previous to the commencement of any operations, there is a probability that advantageous deviations may be made from the route pursued.

Although the form and dimensions of the reservoir, are objects of importance, it is now premature to point out the particular mode of construction I would recommend to be adopted ; yet it may not be improper to give a general outline thereof, as perhaps it may tend to remove many of the prejudices which have been entertained against the supposed impurity of the waters of the Bronx. It is proposed to divide the reservoir into three parts, two of which will again be subdivided ; each of these minor divisions capable of containing a daily supply of water. The first division, or reservoir of reception, will contain the water as immediately delivered by the cylinder of discharge ; while one of its subdivisions is filling, the other in a quiescent state, will be depositing the adventitious matter, with which the water may be intermixed. After so remaining twenty-four hours, it will be drawn off by an aperture near the bottom (so as to prevent any buoyant particles from entering) into the reservoir of filtration, where it will still further purify itself, by gradually depositing the remaining sediment, until it is finally received into the reservoir of distribution, after percolating through a bank of washed sand and gravel, (in imitation of that natural process to which all water owes its purification.) —This last reservoir it is proposed to arch over, so as to preserve the water pure and cool ; from hence it will be distri-

buted in separate and distinct pipes, through every part of the City.

The water destined to cleanse and cool the streets, may be taken immediately from the reservoir of reception, as I conceive it is not necessary that it should be very pure.

The surplus water which, for a considerable part of the year, will not be wanted for washing the streets, may be applied to a variety of purposes, but none more useful or advantageous than the supply of Dry Docks, which may be constructed to receive the largest ships.

If the water in the Collect is deemed adequate to all the purposes of domestic consumption, it must be raised by means of a steam engine into a reservoir; the situation before mentioned, will in this case be very convenient. Although one engine might be constructed, so as to raise both the water for washing the city and for family use; yet, as from the quantity necessary to be raised, it would be unwieldy in its parts and more liable to accident, and also as two-thirds of its powers would be useless the greatest part of the year, I believe it will be most adviseable to erect two; the first destined to raise the water for cleansing the streets, placed at the foot of the hill, to the northward of the hospital; which would be supplied with water from a reservoir made in the adjacent low ground. This would be replenished twice in twenty-four hours by the tide, by means of an open canal or culvert, communicating with the reservoir. The small engine might be placed near the other, the pump well being supplied with water from the Collect, conveyed in a culvert or pipes. The following calculations of the dimensions of the largest engine, will be found sufficiently correct, to enable you to form a tolerable idea of the annual expense attendant on it. Admitting the quantity (as before calculated) to be sufficient, we find that 2,200,000 gallons, or 358,640 cubic feet must be daily raised. Supposing the engine to work sixteen hours out of twenty-four, we have 22,477 feet to be raised every hour, or nearly 375 every minute, estimating ten strokes to be made in a minute, each stroke must yield 37½ feet; but as pumps generally fail in producing the calculated quantity, say 40 feet per

stroke; and if the lengths of the strokes are eight feet, it will require a pump of $30\frac{2}{7}$ inches diameter; but a pump of that dimension would not answer in practice; it will be necessary therefore, to diminish the diameter and increase the number of pumps; six of $12\frac{3}{4}$ inches will be equal in area to that before mentioned. As the water would be raised about fifty feet, the weight of the column would be 15,613 pounds, which would require a cylinder of $44\frac{2}{7}$ inches diameter (allowing the active power of Messrs. Bolton and Watts' engines to be eight pounds on every circular inch) such an engine would consume about 33.1 pounds of coal per hour.

Having thus given you every information necessary to be known for your guidance, I shall conclude, by remarking, that my objections to the Collect, being founded on the doubts I entertain of its efficiency to supply the annual increasing demand of this improving City, and to the contamination of its waters will be subject to) will be done away altogether, when it shall be made to appear that they are groundless; in such a case there can be no question, which plan is most eligible, as it respects the time and expense of execution.

I am, Sir,

With Respect,

Your obedient Servant,

WILLIAM WESTON.

The Hon. RICHARD VARICK.

NEW-YORK, MARCH 14, 1799.

Printed by order of the Common Council,

ROBERT BENSON, Clerk.

BOARD OF ALDERMEN.

DECEMBER 24, 1832.

The following Report was received, and Referred back to the Committee on Fire and Water.

J. MORTON, Clerk.

The Committee on Fire and Water, to whom was referred the Resolution of Mr. BRUEN, of the Board of Assistant Aldermen, requesting authority from the Legislature, to contract a Loan of Two Millions of Dollars, for the purpose of supplying the City with pure and wholesome water,

Beg leave to Report :

That they have, in addition to the information already in the possession of the Common Council, obtained a Report from Messieurs Dewey and Serré, in relation to the Bronx River and its tributary streams. Also, a Report of the Chemical Analysis of the Water, from Messrs. Griscom, Chilton and Ackerly, all of which demonstrate, that from this stream an ample supply of good water can be readily obtained.

They also submit a Report of Colonel Clinton, upon the subject generally ; which demonstrates, that from the Croton River an inexhaustible supply of wholesome water can be obtained, and introduced into the city without the aid of machinery. Upon the superiority of either of these plans, they abstain from passing any

opinion: enough, however, has been ascertained, to prove to the satisfaction of the Committee, that no time ought to be lost in obtaining authority from the Legislature, to raise by loan, such a sum of money as may be required for so desirable an object. They therefore, upon a full investigation and deliberate examination of the subject, would recommend a concurrence with the Resolution of the Board of Assistants; and that the Counsel for the Corporation be directed to prepare an application to the Legislature, to carry the resolution into effect.

JAMES PALMER,
GEO. W. BRUEN,
CHAS. HENRY HALL,
WM. MANDEVILLE.

New-York, December 22, 1832.

The following Report and Law were presented, and Adopted.

By the Board of Aldermen, January 7, 1833.

By the Board of Assistants, January 14, 1833.

Approved by the Mayor, January 17, 1833.

J. MORTON, *Clerk.*

The Committee on Fire and Water, to whom were referred the annexed Report and Resolution, on the subject of applying to the Legislature for the passage of an Act authorizing the Corporation to borrow a sum not exceeding two millions of Dollars to supply the City of New-York with water,

RESPECTFULLY REPORT:

That, considering it as admitted on all hands that Legislative aid will be required to enable the Corporation to carry into effect any project which may ultimately be adopted, for procuring a sufficient supply of water, for the use of the Inhabitants of this City, the Committee have directed their attention particularly to the nature and provisions of the law which should now be applied for by the Common Council; and they have deemed it their particular duty to determine upon such course of proceeding as may procure for the Corporation all the requisite powers for accomplishing this great work, according to any plan hereafter to be adopted, without forming or expressing any opinion as to which of the various projects already proposed for that purpose, should be preferred.

It is well known to the Common Council, that an Act of the Legislature, intended to confer powers on the Corporation of this City for supplying it with water, has already been applied for with-

out success. Whether such should have been its fate, it is not perhaps necessary to inquire ; the fact that objections were made to it, which prevented its passage, is sufficient to raise doubts as to the expediency of renewing the application in the same form ; and the Committee, after much deliberation, and having bestowed their best judgment upon this point, have come to the conclusion, that a similar application would, in all probability, again meet with a similar fate, and that good policy now requires that a different course should be pursued.

The Committee have ascertained to their satisfaction, that the ground upon which the law applied for at the last session of the Legislature was defeated, was in substance, that no law should be passed authorizing the Corporation to borrow or expend money to such an extent as would be needful for a project of this nature, until it should satisfactorily be shown that the object in view, both as to the quantity and quality of the water would be attained by such expenditure. In answer to this objection it might be urged, that scientific men have already examined the subject, and that their reports leave no room to doubt the practicability of obtaining an abundant supply of pure water for the City in different ways, and that they have made estimates of the probable expense of carrying their plans into effect. It must be admitted, however, that the views of all the different Engineers who have made reports on this subject do not agree, either as to the fittest plan to be adopted, or as to the probable cost of accomplishing the work ; and it is certain, that even if the Common Council had all the requisite powers, no particular plan of operation has yet been definitively settled or agreed upon by that body.

To obviate the difficulty therefore, which has already impeded this subject before the Legislature, it has been suggested that a law should now be applied for, simply providing for the appointment of a Board of Commissioners, who should be invested with full powers to examine all the plans which have hitherto been proposed—to cause actual surveys to be made—to have the water tested—to estimate the probable expense, and generally to do whatever, in their judgment, may be necessary to arrive at a right

result, as to the best mode of effecting the proposed object, and the amount of money necessary to be obtained and expended for that purpose ; and requiring such Commissioners to make a report of such result, not only to the Common Council, but to the Legislature, for their information.

It will be perceived, that the object of getting such a law past, is to put at rest all cavilling which might arise in the Legislature, as to the feasibility of the project, or as to the probable cost thereof, by having a report on the subject, from a board of competent and disinterested men, who should not only review the opinions of others, but exercise their own judgements from actual examination, and who should have the power to call to their aid, the talents of such engineers and men of skill as they might think fit ; and it will be obvious also, that such law, being merely passed to obtain and furnish to the Legislature correct information, must be followed by an application for another law, which shall confer upon the Corporation the necessary powers ; this would appear to create some delay, but such would not, in fact, be its operation : the Corporation want no powers until they have determined upon their plan of proceeding ; and this it may fairly be presumed, would be settled by the report of the Commissioners to be appointed by the proposed law. Those Commissioners would have ample time to complete their report, previous to the next session of the Legislature ; and the application for giving the necessary powers to the Corporation could be then made, and would, it is confidently believed by the Committee, meet with no opposition.

To enable the Common Council to examine the report of such Commissioners, and to prepare in season for the necessary application to the Legislature, founded thereon, the Committee suggest that the law should provide for having a copy of such report furnished to the Common Council, on or before the first day of November next, and that the report should be made to the Legislature, during the first week of its next session.

Having determined upon the expediency of applying to the Legislature, during its present session, for a law to this extent only, in preference to renewing the application heretofore made, the

Committee have deliberated upon the fittest mode of having such Commissioners appointed, and of what number they should consist ;—various modes of appointment have been suggested, viz :—by the Common Council, by the Supreme Court, by the Legislature in the act itself, or by the Governor and Senate. They have concluded to recommend the last mentioned mode of appointment as the least objectionable ; and they are of opinion that the number of such Commissioners should be at least five, inasmuch as the object of their appointment is to settle conclusively upon the plan to be adopted, and the amount requisite for its performance, and to satisfy the Legislature as well as the citizens of New-York on these points, and it is therefore important to give the report of such board of Commissioners, the weight to be derived from the number, as well as the respectability and intelligence of its members.

The Committee, with these views deem it inexpedient to make such application to the Legislature as is specified in the annexed report and resolution, but they have directed the accompanying draft of a law to be prepared, which they respectfully submit to the Common Council, and offer the following resolution :

Resolved, That the Counsel cause the same to be laid before the Legislature, with a suitable memorial for its passage, and that such memorial be authenticated in the usual mode.

JAMES PALMER,
WM. MANDEVILLE,
CHARLES HENRY HALL,
D. McCARTHY,
PETER S. TITUS.

AN ACT

To appoint Water Commissioners for the City of New-York.

The People of the State of New-York, represented in Senate and Assembly, do enact as follows :

§ 1. The Governor shall nominate, and with the consent of the Senate, shall appoint five persons to be known as the Water Commissioners for the City of New-York.

§ 2. It shall be the duty of the said Commissioners to examine and consider all matters relative to supplying the City of New-York with a sufficient quantity of pure and wholesome water, for the use of its inhabitants, and to the amount of money necessary to effect that object.

§ 3. The said Commissioners shall have power to employ Engineers, Surveyors, and such other persons as in their opinion may be necessary to enable them to fulfil their duties under this Act.

§ 4. The said Commissioners shall make a Report of their proceedings under this Act, which shall contain their opinion as to the best plan of furnishing the City of New-York with a sufficient supply of pure and wholesome water, and an estimate of the expense of carrying such plan into effect. Also, the reasons and calculations upon which such opinion and estimate may be founded ; and generally all such information connected with the object of their appointment, as they may deem important.

§ 5. The said Commissioners shall present a copy of the said Report to the Common Council of the City of New-York, on or before the first Monday of November, of the year one thousand eight hundred and thirty-three, and their said Report shall be made and presented by them to the Legislature, on or before the second Monday of January, of the year one thousand eight hundred and thirty-four.

§ 6. In case of the death or resignation of any of the said Commissioners, the vacancy shall be supplied by the person administering the government of this State ; and a majority of the said five Commissioners shall constitute a board or quorum for the transaction of their business.

§ 7. All reasonable expenses to be incurred under this Act, shall be paid by the Mayor, Aldermen, and Commonalty of the City of New-York.